THIRTIETH ANNUAL REPORT

OF

THE LOCAL GOVERNMENT BOARD.

1900–01.

SUPPLEMENT

CONTAINING THE

REPORT OF THE MEDICAL OFFICER

For 1900-01.

Presented to both Houses of Parliament by Command of His Majesty.

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PUBLIC HEALTH.

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FOR THE YEAR

1900-01.

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REPORT.

MEDICAL OFFICER'S REPORT.

TO THE RIGHT HONOURABLE WALTER HUME LONG, M.P., PRESIDENT OF THE LOCAL GOVERNMENT BOARD.

SIR,

I HAVE the honour to submit herewith a record of the work carried on in the Board's Medical Department in 1900-1901.

There have not been during the year any changes among the professional officers of the Department. With a view, however, of extending the Medical Officer's observation of local non-professional officers in their administrative relation with vaccination and public health, Mr. C. J. Huddart, the Medical Officer's Statistical Assistant, has been appointed Assistant Inspector in the Medical Department. The vacancy thus caused in the clerical staff of that Department has been filled by promotion of Mr. F. H. O. Jerram.

The Directorship of the Animal Vaccine Establishment, rendered vacant by the death of Dr. Cory, has been assigned to Mr. Thomas S. Stott. Dr. Leslie Thorne-Thorne has replaced Mr. Stott as Assistant Director.

VACCINATION AND PUBLIC VACCINATION.

VACCINATION OFFICERS' RETURNS.

In Appendix A, No. 1, is a summary of Vaccination Officers' Returns as to the condition, on 31st January, 1900, in regard of vaccination of the 923,059 children whose births were registered in England and Wales during 1898. Of the children in question, not quite 61·0 per cent. were returned as successfully vaccinated, some 12 per cent. as having died unvaccinated, and 0·35 per cent. as "insusceptible," or as having had small-pox. The remaining 26·7 per cent., including "postponements," "removals," and "conscientious objections"* represented a far

* "Conscientious objection" became, under the Vaccination Act of 1898, for the first time registrable on 12th August in that year. Thereafter, during four months, it was open to parents to apply for certificates exempting from vaccination children born before the passing of the Act. As a result of this period of grace, no fewer than 203,413 certificates of "conscientious objection," relating to 230,147 children, were received by the Vaccination Officers of England and Wales. Mainly these children were aged one year and upwards, since, as will be seen from Appendix A, No. 1, less than 50,000 certificates of "conscientious objection" were received in regard of infants whose births were registered in 1898.

MEDICAL OFFICER'S REPORT.

larger amount of abstention from vaccination than any yet recorded in the Reports of your Medical Officer.

As in former years, the metropolis is, as regards the protection against small-pox adopted for its infant population, at a disadvantage compared with the rest of the country, a fact which is conveniently exhibited in the subjoined table.

Periods.	Percentage Abstention from Infantile Vaccination.	
	Metropolis.	Rest of England and Wales.
Average of 1873-77 ...	8·1	4·1
" 1878-82 ...	6·8	4·4
" 1883-87 ...	7·4	5·7
" 1888-92 ...	14·1	11·2
" 1893-97 ...	23·9	19·7
Single year, 1898 ...	34·4	25·4

INSPECTION OF PUBLIC VACCINATION.

The number of unions inspected in 1900 in regard of vaccination amounted to 285, comprising 1,420 Public Vaccinators' Districts. The Public Vaccinators of 1,024 of these Districts were recommended for award under Section 5 of the Vaccination Act of 1867 (Appendix A, No. 2).

EDUCATION IN VACCINATION.

In Appendix A, No. 3, will be found a list of Educational Vaccination Stations,* with the names and addresses of the Teachers of Vaccination authorised, under Orders of the Board, in England and Wales, Scotland, and Ireland, to grant the special certificates of proficiency in vaccination necessary as part of the medical qualification for entering into contracts for the performance of public vaccination.

NATIONAL VACCINE ESTABLISHMENT.

In 1900, small-pox being practically absent from England and Wales, glycerinated calf lymph was, in response to 50,512 applications from public vaccinators, issued to the amount of 444,221 capillary tubes.

ANIMAL VACCINE ESTABLISHMENT.

The Director of the Animal Vaccine Establishment, Mr. Thomas S. Stott, reports (Appendix A, No. 4) that, during the year ending March 31st, 1901, the number of primary vaccinations performed at the Board's Station in Lamb's

* The list in question has, while this report is passing through the press, been corrected to 31st December, 1901.

Conduit Street, amounted to 1892. He notes that the "insertion success" (five separate insertions of lymph being made on each child) obtained there was 98·22 per cent. The total number of primary vaccinations performed at this station compares unfavourably with that for the preceding year. This falling off, Mr. Stott refers less to preference under the new law for domiciliary vaccination of infants, than to neglect of Registrars to apprise parents, on the occasion of registration of birth of their children, of the fact that gratuitous vaccination with calf lymph is still to be obtained at the Board's establishment in Lamb's Conduit Street. As regards re-vaccination, the "insertion success" obtained at the Board's station was 95·55 per cent.

GLYCERINATED CALF LYMPH.

The work, actual and prospective, devolving during the year upon the Board's glycerinated calf lymph establishment necessitated definite increase, alike in staff and in laboratory accommodation. At the same time it was requisite, while obtaining further accommodation for calves, to group the additional temporary calf stables in the most convenient manner attainable, so as to avoid adding to the already serious loss of time which our experts and calf attendants were incurring in consequence of the several sections of our total establishment being dispersed in various separate localities. Happily, the actual demands on our resources were not unequally distributed in the different seasons of the year. There was, as has been said, practically no epidemic small-pox, and thus we escaped the sudden and excessive demands for lymph for re-vaccination which, to the detriment of the establishment, had been experienced in the previous year.

In Appendix A, No. 5, Dr. Blaxall reports in detail on the operations of the establishment under his charge in 1900-1901; and in Appendix C will be found papers dealing with questions concerning calf lymph in its biological aspects, by Dr. Blaxall, Mr. Fremlin, and Dr. Green, upon which I propose to comment later on.

Other Administrative Business of the Medical Department.

Conference at office on public health matters with other departments of Government, with members and officers of local sanitary authorities, and with representatives of various public bodies at home and abroad have increasingly occupied the Medical Department. Interchange in this way of information and experience has been in the past, and promises in the future to be, of definite advantage to the several parties concerned. Thus, conferences have been held with the object of determining suitable course of action in instances where administrative functions, correlative with public health, of different departments of Home Government interlace or overlap. By similar means

consideration has been given to questions of applying, in dependencies of Great Britain, principles of public health administration which govern our home procedures, whether these are based on legal enactment or on international understanding. Interviews with representatives of local sanitary authorities on the other hand have necessarily been concerned with matters of a more domestic order, for instance, local bye-laws, projected hospital schemes, provision of disinfecting apparatus, appointment of Medical Officers of Health, and the like. Experience has been exchanged with professional advisers of public bodies at home and abroad, especially upon epidemiological questions in their scientific and administrative aspects, in which subject matters the information at the disposal of the Medical Department is increasingly sought by experts and administrative officers not only of our own but of other countries.

In addition to assistance in the above sense rendered by the staff at office, the Medical Inspectors have in regard of like subject matters paid visits to and held conference with many sanitary authorities and their officers in England and Wales. Informal conferences of this nature have, I believe, proved of advantage to the sanitary authorities and their officers, and at the same time have served a useful purpose in exhibiting to the Board aspects of local affairs not always prominent as a result of inquiries of a formal character.

Formal inquiries, routine and other, as also inquiries of an investigatory nature, have, as in former years, been undertaken in much variety and abundance by the Medical Department. Such inquiries have been in almost every instance carried out by medical inspectors single-handed. Exceptionally the inspector has been aided by, or has furnished aid to, other departments of the Board, as, for instance, the Engineering and Architectural Departments. The total work, formal and informal, of the medical inspectors in the several directions above indicated, is set out in summary in Appendix A., No. 6; a summary which sufficiently illustrates the multiplicity of the functions which the inspectors of the Medical Department are called upon to exercise.

In Appendix A, No. 7, abstracts will be found of formal reports by medical inspectors on about a score of districts in which detailed inquiry became requisite on account of outbreaks of disease, or by reason of defective local sanitary administration. Certain of these reports illustrating the sanitary shortcomings, the defects of administration, and the conditions of disease prevalence, which continue from time to time to call for the Board's intervention, are reproduced in this volume.

OSTON.

The history of sanitary administration by the Town Council of Boston, in Lincolnshire (Appendix A, No. 8), exhibits the disposition of certain local authorities to remain content in sanitary matters with the methods and procedures of their predecessors. In this district, which has a population of some

16,000, sewers have been formed in the past by the covering in of ancient ditches, and generally they have been so constructed as to render the complete discharge of their contents impracticable. Furthermore, the main sewer outfall has been so contrived that much sewage is delivered into the River Witham at a point which entails its passing in its course seawards through the town. The method of excrement disposal is also defective. A farmhouse is the sole accommodation for infectious sickness in this and in neighbouring districts together comprising some 30,000 to 40,000 inhabitants. There is no disinfecting apparatus. The byelaws are out of date; and a particular byelaw, which provides that no new dwelling shall be occupied until the surveyor shall have given a certificate as to the proper construction of its drainage, has been observed in a single instance only out of the 235 in which that duty devolved upon the surveyor. In a word, the Boston Town Council is apparently concerned rather in furnishing plausible excuses for its shortcomings than in setting to work to improve the conditions of its district, and this notwithstanding the fact that both enteric fever and diarrhœa prevail to an altogether undue extent within the area of its jurisdiction.

NORTHAM.

The Northam Urban District (Appendix A, No. 9), which had in 1892 a population of 5,043, comprises four separate aggregations of population, one of which, Westward Ho!, is a well known "health resort." It is a district which, although abounding, as Dr. Reece reports, in sanitary defects, has been sufficiently served, in the estimation of its Council, by such medical advice and assistance as has been procurable for £10 per annum. In these circumstances, and under a series of repeatedly changed inspectors of nuisances, earning no more than £40 yearly, nuisances have not been dealt with, isolation accommodation has not been provided, and proper means have not been adopted for the disinfection of infected articles.

BISHOP AUCKLAND.

Bishop Auckland (Appendix A, No. 10), recently the subject of representation by the Durham County Council as a place in "gravely insanitary condition," is a town of 10,527 inhabitants which has long been under the Board's notice in consequence of repeated outbreaks of enteric fever. Dr. Wheaton, as the result of his inspection of this town, finds that its water supply is derived from the river Wear, a stream which, a few miles above the waterworks intake, is polluted by the sewage of a considerable population; and that notwithstanding this fact, river water is from time to time delivered to the townspeople in an altogether unfiltered condition, a proceeding which Dr. Wheaton rightly characterises as "absolutely unjustifiable." The sewerage of the place is unsatisfactory; drains have been connected with the public sewers without proper supervision; the "fall" of some sewers is in a direction opposite to that originally intended. The old-fashioned privy midden system of excrement disposal has been to a large extent retained; the walls of middens are not

watertight, and hence the soil around them is soaked with filth. Scavenging is unsatisfactory, the responsibility for its performance being divided between workpeople of the Corporation and workmen of contractors. It is the business of the former to deposit midden filth in the back streets, the business of the latter to remove it. There is a "temporary" hospital, but no disinfecting apparatus. In Dr. Wheaton's view, in Bishop Auckland the possible agents of dissemination of enteric fever are so numerous as to occasion much difficulty in determining the particular factor mainly responsible for the repeated prevalence of the disease in the town. He, however, is disposed to regard the fever as introduced from time to time through specific contamination of the public water supply, and as spreading among the population by agency of the various unwholesome conditions which have been referred to. The fact that Bishop Auckland is a market town serving a wide and populous area becomes, in Dr. Wheaton's view, a matter of importance. He regards the place as, in its present circumstances, a danger in the matter of enteric fever to its neighbours.

STROUD R. AND NAILSWORTH U.

The Rural District of Stroud in Gloucestershire (Appendix A, No. 11) comprises several very considerable aggregations of population, most of which, as from time to time has been reported to the Board, are deficient in proper systems of sewerage and sewage disposal. In October, 1899, the Stroud Rural District Council complained to the Board of danger incurred by the inhabitants of their district owing to discharge by the adjoining Urban District of Nailsworth of crude sewage into a stream traversing the rural area. A memorial which accompanied this complaint urged inspection by a member of the Board's Medical Staff. It was determined therefore to make inspection of both the sanitary areas in question.

STROUD.

As to the rural district, the inspector, Dr. Mivart, found that water supplies, other than a particular "public water service," were many of them derived from wells liable to contamination in a manner not uncommon in rural districts; namely, by means of imperfect steining or improper covering, and by proximity of the wells to sources of pollution. Generally speaking the rural water supplies were also insufficient, or at least uncertain, in quantity. One only of the aggregations of population was furnished with a sewerage system, and in this case the ultimate disposal of the sewage was faulty. It is, however, satisfactory to note that in regard of this section of its area the Rural District Council has now submitted a comprehensive scheme to the Board. There would appear exceptional need for general reform in the district in this sense, since it is the custom here to cause privies to discharge directly into watercourses. When this method of disposing of excreta is not practicable, these matters are commonly turned into fissures which abound in the local rock to the serious detriment of underground water supplies.

MEDICAL OFFICER'S REPORT.

NAILSWORTH.

The Nailsworth Urban District Council have not sufficiently recognised the responsibilities which devolved upon them as an Urban Council, when the area committed to their jurisdiction became separated from the Rural District in 1894. The dwellings of the poor, for instance, have been permitted to remain in a condition far from satisfactory, and, although nature has endowed the district with an abundance of water, proper advantage of the circumstance has not been taken by the authority. As to sewerage and drainage in Nailsworth, Dr. Mivart reports "that there is no regular or definite system of sewerage in the district." Such sections of sewers as exist pass, some of them, beneath dwellings, and commonly they discharge crude sewage into the stream which traverses the town. As a consequence, the banks of this stream are, it is reported, "in a very foul condition." Excrement is "disposed of" by means of privies erected over the stream, or in privy vaults apt to be mere excavations in the ground. Slaughter-houses, which are unregistered, are apparently uncontrolled, and refuse from the slaughter-houses is got rid of into the stream.

NUNEATON AND CHILVERS COTON.

The occurrence, at Nuneaton with Chilvers Coton (Appendix A, No. 12) of above 100 cases of enteric fever in the course of four months, in a population of some 23,000, led to investigation by Dr. Johnstone of the sanitary circumstances of the areas involved.

The Inspector found in this rapidly-increasing commercial town, conditions which are unhappily all too common in Midland and Northern towns of similar type. Dwellings are without sinks or wash-houses, windows are not made to open, walls are damp and dirty, roofs are defective. The unwholesome and out-of-date midden privy system of excrement and refuse disposal is maintained; erection of middens being still allowed by the District Council, even in localities where sewers are available. The condition of middens was generally, Dr. Johnstone reports, moist and offensive. In these huge receptacles, sunk commonly below the ground level, excrement and refuse is allowed to accumulate almost indefinitely. They are "cleansed" by the District Council. As might be anticipated, such "cleansing" is not infrequently attended with much nuisance. The drains of the place are old and leaky, and the older sewers are in like manner defective. In the circumstances it is not matter for surprise that the water in many of the local shallow wells is found to be polluted; out of 87 samples of such well water which were recently examined, no less than 76 were pronounced unfit for drinking purposes. A public water service is in existence, but unfortunately the water is objected to on account of frequent turbidity or discolouration due to oxide of iron. It is hoped, however, to correct this quality by filtration.

Enteric fever would appear to be now endemic in this district. For several years the death rate from this disease has here been in excess of that for England and Wales as a whole. The chief

MEDICAL OFFICER'S REPORT.

incidence of the outbreak which was the object of Dr. Johnstone's inquiry was upon a certain area noted for its insanitary courts and for the squalor of the inhabitants. Dr. Johnstone is disposed to associate the fever here with soil contamination resulting in polluted well waters, while deeming personal infection an additional agency in the propagation of the disease.

HEXHAM.

The behaviour of typhus fever at Hexham upon which Dr. Manby makes report (Appendix A, No. 13), emphasises once again the well-known fact that when this particular disease is introduced into overcrowded tenements, such as were in question at Hexham in the block of buildings known as the "Mystery," it is apt to manifest, as of old, exceptional infective power, and to prove highly fatal to adults over 40 years of age.

The manner in which typhus spread at Hexham is well shown in the chart at the end of Dr. Manby's report.

At Hexham, as has often proved the case in outbreaks elsewhere, the true nature of the earlier attacks was not recognised and others of the cases were thought to be enteric fever. The result of this latter mistake was that two typhus fever patients were introduced into the workhouse infirmary, where they infected two inmates of advanced age, both of whom died.

Outbreaks of this nature serve to indicate the importance of medical men as well as students taking advantage of every opportunity for studying the less frequently met with infectious diseases, as for instance typhus fever, small-pox, and plague, in order that they may recognise anomalous cases of these maladies in time to take the necessary precautionary measures. Such education is especially of importance in the case of Medical Officers of Health, assistance from whom, in the diagnosis of doubtful cases of infectious disease, is as a rule gratefully accepted by the medical practitioners of their districts.

Besides work closely connected with the investigatory and administrative functions of the Board, the Medical Department has been concerned directly or indirectly in other work, some of national, some of international importance.

Towards the end of November, 1900, Dr. E. S. Reynolds drew attention to certain cases of sickness which in recent months had been admitted in large and increasing number to the Workhouse Infirmary of the Township of Manchester, at Crumpsall, and to similar cases occurring among hospital and private patients in Manchester; and he furnished evidence that their illness was to be attributed to poisoning by arsenic in beer. Almost at once it became recognised that similar cases had been recently occurring in large numbers among beer drinkers in many parts of England, more particularly in Lancashire and Staffordshire. Investigation by Dr. Tattersall, Medical Officer of Health of Salford, and by others, soon established the fact that the implicated beer, which came from a plurality of breweries, had become arsenicated by the use in its preparation

of "brewing sugars" manufactured by a particular firm. Relatively large amounts of arsenic were detected in these brewing sugars and in the sulphuric acid used in their preparation.

As soon as the epidemic was reported as affecting a large number of separate administrative areas, Dr. Buchanan was instructed to visit places known to be affected, in order to collect information for the Board on the matter; and shortly afterwards Dr. Darra Mair, with similar instructions, was associated with Dr. Buchanan in his investigation. By the beginning of January these inspectors had visited some 23 districts in Lancashire, Cheshire, Staffordshire, Worcestershire, and other counties. Meanwhile the inspectors watched closely from the view-point of public health the various developments which the subject of their inquiry underwent, as more knowledge came to be acquired concerning the extent of the epidemic, its causation, and its consequences. The problems which arose proved numerous and complicated, involving (to give only a few instances) questions of the relation of poisoning by arsenic in beer to the disease "alcoholic neuritis," which it had heretofore been customary to refer solely to poisoning by alcohol as such; questions of the extent to which arsenical poisoning, though unrecognised, had occurred, both during and antecedent to the epidemic of 1900; of the safety, in regard of arsenic, of all chemically manufactured sugars used in this country for brewing and for other purposes; and of the precautions requisite to safeguard the public against risk from introduction of arsenic along with "chemical" ingredients of beer and other articles of food and drink. Moreover, facts came to light indicating the liability of beer to become arsenical in other ways than by the use of arsenical brewing sugars, and important questions arose concerning the extent to which it is practicable to require the exclusion of minute quantities of arsenic either from beer or from other articles of food or drink.

It was in large measure due to the information furnished by the inspectors that the Board were enabled from the first to foresee the importance which these matters would speedily assume, and that you presently decided to counsel the appointment of a Royal Commission to examine the whole subject of arsenic in relation to food in its medical, chemical, technical, and administrative aspects.

The Royal Commission on Arsenical Poisoning, of which Lord Kelvin is Chairman, was appointed on February 4th, 1901. Before that date, however, Dr. Buchanan had been directed to prepare a report on some of the principal matters upon which he and Dr. Mair had obtained information. His report, which was received on January 25th, 1901, was presented to Parliament in the following month. Dr. Buchanan was subsequently appointed Secretary to the Commission.

The Board has through its Medical Staff continued to advise the Foreign and Colonial Offices as regards Ordinances

and Regulations for systematic repression of disease in Dependencies and Colonies in various quarters of the Empire.

An International Congress of Hygiene and Demography being held at Paris in the autumn of 1900 at which particular questions of Public Health were to come under discussion, Dr. Theodore Thomson was deputed to attend the Congress on the Board's behalf. Dr. Thomson's visit to the French capital was, at the Board's direction, and in view of the possible agency of rats in diffusion of plague, utilised by him in observation of certain experiments that were being conducted there by M. Danysz as to the practicability of poisoning rats within sewers by feeding these animals with cultures of a particular pathogenic micro-organism.

A formal inquiry having been determined on by Government into the sanitary state of the city of Dublin, the services as a member of the Committee of Inquiry of one of the medical inspectors were sought by the Lord Lieutenant of Ireland; and the Board assenting, Dr. Theodore Thomson was charged with the duty in question. The report of the Committee has since been issued.

The Royal Commission on Sewage Disposal continued its labours during the year, and your medical officer, as a member of this Commission, took part in its proceedings. Your medical officer has also, as a member of the General Medical Council appointed by the Crown, taken part, so far as his office duties have permitted, in the deliberations of that body.

The Departmental Committee on Food Preservatives retained during the year the services of Dr. Bulstrode as member, and of Mr. Huddart as secretary. The report of the Committee, with minutes of evidence, has been presented to Parliament.

Dr. Bulstrode commenced during the year re-inspection of oyster-layings on the coasts of England and Wales, and he extended his investigation in this connection to cockles and other shell-fish.

Upon the appearance of plague within the United Kingdom, Dr. Thomson, with assent of the Scottish Authorities, visited Glasgow while the disease was prevailing there, in order to study the behaviour of plague in response to the measures locally adopted for its repression. Meanwhile Dr. Buchanan, in association with Dr. Downes, the Board's medical adviser in matters pertaining to the Metropolitan Asylums Board, visited several of the establishments of that Hospital Authority, with a view to determining beforehand the provision which should be made in and near London for isolation of plague in the event of that disease making its appearance in the Metropolis.

In continuance of the practice adopted by my predecessor in office, I submit in Appendix A., No. 14, quarterly returns for 1900, of the notified attacks and the registered deaths from

certain infectious diseases in 94 urban sanitary districts of England and Wales. These data are compiled from records of notifiable diseases which are received weekly by the Board, under arrangement voluntary as regards the districts concerned, from the local medical officers of health.

In Appendix A., No. 15, similar data are given weekly and quarterly for the several sanitary areas of the Metropolis.

In Appendix A, No. 16, will be found the various memoranda on Public Health matters prepared or revised by your Medical Officer during 1900. These were :—

(1.) On the Provision of Isolation Hospital Accommodation by Local Authorities. Revised, August, 1900.

(2.) Plague Memorandum. Prepared, September, 1900.

(3.) Directions for the use of the Haffkine Plague Prophylactic. Prepared, September, 1900.

(4.) Directions for obtaining and forwarding for Bacterioscopic Examination Material from Suspected Plague Cases. Prepared, September, 1900.

(5.) General Memorandum on the Proceedings which are advisable in places attacked or threatened by Epidemic Disease. Revised, September, 1900.

(6.) Memorandum as to Annual Reports of Medical Officers of Health (London). Revised, December, 1900.

(7.) Memorandum as to Annual Reports of Medical Officers of Health (Provinces). Revised, December, 1900.

In my report for last year I noted that Dr. Parsons, one of your Assistant Medical Officers, had been appointed member of the Departmental Committee charged with inquiring into the organisation and staff of the Geological Survey, and that in connection with the operations of this Committee, he had prepared a memorandum "On the utility of the Geological Survey in relation to questions of Public Health and Sanitary Administration coming under the cognisance of the Local Government Board." Dr. Parsons' report to the Board "On Geological Considerations in relation to Public Health and Sanitary Administration," upon which the memorandum in question was based, I now reproduce in Appendix A, No. 17.

Plague.

Dr. Bruce Low has continued his studies of the progress and diffusion of plague, and he supplies, in Appendix A, No. 18, a further memorandum on the subject. In Appendix A, No. 19, he records the several cases of plague or suspected plague coming under the notice of sanitary authorities in this country during the year 1900, giving account also of the special measures

adopted by the Board and by local authorities in England and Wales against importation and spread of the disease. Dr. Theodore Thomson furnishes, in Appendix A, No. 20, details as to the preparedness in an administrative sense of our several port and riparian authorities to successfully resist importation of plague, and makes comparison of the different ability in 1893–94 and 1897–1900, of the various sections of our first line of defence to deal satisfactorily with importation of exotic disease.

Throughout the year 1900–01, the diffusion of plague and the behaviour of the disease in the several countries invaded by it, received the sustained attention of the Medical Department. It has been our object to keep under special supervision those of our port and riparian districts which were being specially exposed to danger of importation of plague through trade with countries and places where the disease had obtained, or was obtaining, epidemic prevalence. In this way considerable increase of plague in South America during the spring months of 1900, brought about a visit by the Board's medical inspectors to a number of our ports having trade with that continent; and later in the year (August and September) when plague manifested itself in Glasgow, survey of our ports was renewed on a still more extended scale. Altogether, during 1900, 57 port and riparian districts were visited by the Board's inspectors.

The points to which the attention of the inspectors was to be especially directed were :—

(*a.*) Need for familiarity with the provisions of the Board's Order of 9th November, 1896, on the part alike of officials of the local sanitary authority and of officers of Customs, and for ensuring the due co-operation of these officers in exercise of their respective functions, under the Order.

(*b.*) The efficiency of the local arrangements and of the local staff as regards systematic inspection of shipping; and the practice as to medical examination of vessels arriving from suspected or infected ports.

(*c.*) The nature and amount of hospital accommodation provided by the local authority for the isolation of plague or of suspected plague.

(*d.*) The means available for efficient disinfection of vessels, and of bedding, clothing, &c.

In addition each inspector was to bring to the notice of the local officers concerned the not unlikely danger of importation of plague by means of rats ship-borne from plague-infected localities. Having regard to the absence of satisfactory and non-costly methods of destroying rats on ship-board, immediately on the arrival of a vessel, and while her cargo remains *in situ*, the inspector was to discuss with the local officers the various means which could be adopted by them for preventing access of

ship-borne rats to shore during discharge of cargo, and means also of destroying rats on board empty ships, and in warehouses, dwellings, and sewers ashore.

While thus inciting local authorities to vigorous action in repression of plague, the Board continued mindful of Government responsibility to the same end. As in 1899, therefore, the Board kept in hand, and later on considerably increased, their stock of Haffkine prophylactic, for issue to port and riparian authorities for the protection of persons exposed to infection of plague ; and have been, as before, prepared to test bacterioscopically, without expense to the authority, material from suspected plague cases arrested in our ports. Furthermore, in view of long-foreseen possible administrative difficulties in the matter of plague-infected rats, experiment was, at the instance of the Board, undertaken by Dr. Haldane as to means of destroying rats on ship-board without disturbance of cargo ; while, as has been said, Dr. Theodore Thomson was instructed to study at Paris M. Danysz's method of wholesale poisoning of these animals by feeding them with artificial cultures of a particular microbe.

On the occurrence of plague at Glasgow, the Board, in view of possible consequent epidemic prevalence of the disease in this country, at once enlarged the sphere of their operations. Plague was, by an Order of the Board, forthwith made compulsorily notifiable throughout England and Wales, and offer of assistance, of the sort already placed at the disposal of port authorities, was extended to every sanitary authority in the country, a circular letter enclosing three memoranda being issued as follows :—

(*a.*) Letter of the Board dated 9th October, 1900.

(*b.*) Directions for obtaining and forwarding for bacterioscopic examination material from suspected plague cases (Appendix A, No. 16).

(*c.*) Memorandum on Plague containing,—

  (1.) Administrative considerations.

  (2.) Symptoms of plague (Appendix A, No. 16).

(*d.*) General memorandum on proceedings which are advisable in places which are attacked or threatened with epidemic disease.

In other ways, too, the Board sought to mitigate risk to England and Wales in the event of plague becoming epidemically established in Glasgow and other quarters of Scotland and England. Conferences were held with the Board of Customs with reference to help to be rendered by that Department of Government to sanitary authorities on the littoral of England and Wales in supervision of coastwise shipping from plague-infected northern home-ports. Epidemic Plague Regulations, general and

particular, were drafted with a view to their prompt issue in the event of the disease extending from Scotland into England and Wales. In this connection and as regards the metropolis, conference was had with representatives of the Metropolitan Asylums Board and of the London County Council as to the functions to be exercised, separately but in concert, by these bodies in the matter of segregation of plague cases, of suspected cases, and of plague-contacts.

It is matter for congratulation that the above measures, actual and prospective, proved in the event in excess of demand for them. Plague in Glasgow was, as a result of the action of the local authority, quickly arrested, and not long after suppressed. In no single instance was there suggestion even of transfer of plague from Scotland into England by sea or by land. So admirable, indeed, in their methods and in their execution, were the procedures adopted in Glasgow that, assent having been obtained from the Scottish authorities, Dr. Theodore Thomson was, as already noted, despatched by the Board to Glasgow to study there the application of Scottish plague measures for our own profit and advantage.

In the above circumstances, the cases of plague and suspected plague with which the Board were called upon to deal in 1900–01, were not other than of the routine sort to which we are becoming accustomed. In nine instances only was suspected "inland" plague reported to us; but in not one of them was the suspicion that had been entertained confirmed bacteriologically. Sea-borne plague or suspected plague, on the other hand, was more often reported than in previous years; not, it would seem, because it was more abundant, but rather by reason of the extra alertness generally of local port officers. Out of twenty-three suspected occasions of "over-sea" transference of plague, the diagnosis was verified in only four instances. In all cases plague was, as soon as detected, stringently dealt with, and in no instance did extension of the disease to other persons occur.

AUXILIARY SCIENTIFIC INVESTIGATIONS.

The "field observations" of the Medical Department have from time to time yielded, and the Board in consequence have published, not a few facts respecting foods of various sort as agents in the dissemination of disease such as Scarlatina, Diphtheria, Enteric Fever, and Diarrhœa. But much has remained to be learned respecting the liabilities of different foods to contain infectious material, the sources whence are derived the infections conveyed by these foods, and above all, the conditions which, when infection germs are present in foods, govern their conservation and multiplication therein. Accordingly, as shown in my report for last year, information has

been sought by the Board in these other directions. In that report I recorded on the one hand, investigation by Drs. Klein and Houston of the raw materials of certain vegetable (starch) foods, such as grain and flour, with reference to the bacteria apt to be associated with them, and as to the potentialities in a pathogenic sense of these microbes; and on the other hand, I noted the results of study by Dr. Klein of the behaviour in certain foods of animal derivation, such as milk, cheese and cream, of definite pathogenic microbes, when bacteria of this description are experimentally added to them. During the year 1900–01, now under review, this procedure has been reversed; the raw materials of starch foods have been tested by Drs. Klein and Houston in reference to their capacity for conserving and multiplying pathogenic microbes, while foods of animal derivation have been studied by Dr. Klein with reference to frequency, or otherwise, of association with them, under the conditions in which they appear on the market. of microbes definitely or potentially pathogenic.

SPECIFIC MICROBES AND CEREAL PRODUCTS.

The experiments of Dr. Klein and Dr. Houston with cereal products (Appendix B, No. 1) comprised wheat-flour, oatmeal, and ground rice; and the chief microbes tested as to their behaviour in artificial media composed of these starch foods were—the typhoid bacillus, the diphtheria bacillus, and the vibrio of cholera. In every instance the flour culture medium was unsterilised, and accordingly, the microbes under test were left in competition always with the bacteria proper or normal to the food stuff of experiment. The results of this research are, so far as they go, re-assuring. In no single instance was there observed tendency of the microbe of experiment to multiply in the medium to which it had been added; on the contrary, whatever the pathogenic microbe, and whatever the flour medium, association of the one with the other in the manner practised proved in a very few days fatal to it. Provisionally, therefore, it may be inferred that, unlike certain other articles of diet, food stuffs of the class here in question are little prone to serve as agencies in epidemic diffusion of enteric fever, diphtheria or cholera.

PRESENCE OF PATHOGENIC MICROBES IN FOODS OF ANIMAL ORIGIN.

The foods of animal derivation (Appendix B, No. 2) which have been examined by Dr. Klein during the year as to the presence in them of pathogenic or other objectionable microbes, have included milk, butter, margarine, and, as well, certain tinned and other preserved foods. The object in view has been, of course, not only to detect in these articles of diet micro-organisms actually or possibly dangerous to consumers of the food, but also to ascertain as regards particular foods on the market the proportion in each instance contaminated or infected in the above way.

(a.) *Milk.*

Ninety-eight separate samples of *milk* derived from different farms in the country were sampled with suitable precautions on arrival at London railway stations. Each sample was tested by

Dr. Klein for tubercle bacilli, the sediment obtained in each instance from 250 cc. being inoculated, half of it subcutaneously into one guinea-pig, the other half intraperitoneally in another guinea-pig. Thus tested, seven per cent. of the samples produced tuberculosis in the experimental animals. Lest undue importance should be attached to this proportion, however, Dr. Klein is careful to point out the marked variations which during different periods occurred in the ratio of tuberculous to total samples. Had he ceased his examination with his first 38 samples, his facts might have been taken to indicate that 15 per cent. of country milk delivered in London is tuberculous; on the other hand, had he restricted his observations to the next 40 samples, they would have suggested that all such milk is free from tubercle. It is not difficult to surmise the probable causes of such variations, but the point should be noted. Obviously it is essential that experiments in sufficient number should be carried over considerable periods of time before attempt is made to contrast the condition as regards tubercle of one milk service with another.

In testing his milk sediments for tubercle, Dr. Klein has been careful to eliminate "acid-fast" cylindrical bacilli morphologically resembling true tubercle bacilli, and sometimes (as I indicated in last year's report, misleadingly) termed "pseudo-tubercle" bacilli. The "bacillus pseudo-tuberculosis" of A. Pfeiffer, with which Dr. Klein dealt last year, was met with in eight milk samples. One other definitely pathogenic microbe was detected by Dr. Klein once only in a single sample of milk sediment. This was a seemingly hitherto undescribed yeast, the source of which can only be conjectured. In addendum to his report Dr. Klein gives a detailed account of the blastomycetes in question, along with means for differentiating it from allied micro-organisms.

Apart from the microbes already referred to, over 30 per cent. of the guinea-pigs inoculated subcutaneously and intraperitoneally with milk sediment showed local pus formation associated with staphylococcus pyogenes aureus, with streptococcus pyogenes, with streptococcus longus or brevis, or with bacillus coli. As Dr. Klein points out, the presence of these pyogenic organisms in milk, though possibly without significance so far as the healthy individual is concerned, may well attain importance when the milk is brought into contact with already damaged tissues — for example, a diseased tonsil. In this connection Dr. Klein records some interesting results of examination of secretion obtained from chronic inflammatory non-tubercular lesions of the udder in 20 milch cows. In most instances the secretion was associated with common pyogenic micro-organisms; in one instance a hitherto undescribed variety of streptococcus, which Dr. Klein terms *streptococcus radiatus pyogenes* was met with; in another, a pyogenic micro-organism similar morphologically and in certain cultural aspects to the

diphtheria bacillus, and named by Dr. Klein *bacterium diphtherioides*.

(b.) *Butter and Margarine.*

Twelve samples of *butter* of diverse origin were emulsified with sterile salt solution, placed in the ice chest, and there allowed to form sediment. Each sample was then tested by inoculation into guinea-pigs, each animal receiving, peritoneally or subcutaneously, sediment representing two ounces of butter. No diseased condition was produced in 21; one died from unknown cause; two developed local abscess due to staphylococcus aureus. No diseased condition was developed by twelve animals inoculated with sediment similarly obtained from six samples of *margarine* of different origin.

(c.) *Tinned and other Foods.*

Samples of *tinned food-stuffs*, namely, eight of condensed milk, four of tinned salmon, and four of tinned "potted ham," were examined for the presence of bacillus coli or allied forms, of pathogenic anaërobes, and of pathogenic cocci. No such micro-organisms were demonstrated in platinum loopsfull of material taken from any of the tins. None, however, were sterile. The same microbes appeared to be absent from four meat pies, three samples of German sausage, and three of "black pudding." Certain bacilli found in these preserved meats, including a spore-bearing bacillus which otherwise presented remarkable resemblance to B. typhosus, proved non-pathogenic to rodents.

SCARLATINA AND STREPTOCOCCUS.

In his report for last year on the intimate pathology of scarlatina, Dr. Mervyn Gordon showed that a fatal result in this disease is to be attributed to invasion of the blood and organs by streptococcus. And, further, he obtained indication that the mucous membrane of the tonsil and pharynx is in all cases the site of the primary fatal streptococcus invasion.

Acting on this indication, Dr. Gordon has in 1900–01 resorted to more exact study (Appendix B, No. 3) of the tonsillar mucus in health and disease, employing for his purposes a method of estimating approximately the *relative* abundance of the different micro-organisms present in this secretion. His attention in this sense has been given in the first instance, and chiefly, to the tonsillar secretion of scarlatina—by preference, scarlatina of mild uncomplicated type. But also he has examined the tonsillar secretion in doubtful cases of this malady, and, for purposes of comparison, in attacks of diphtheria also.

Dr. Gordon infers, as a result of these and further parallel observations, that the graver manifestations of scarlatina are due, not to a single, but to a twofold agency. That the infectious malady scarlatina is to be referred to streptococcus scarlatinæ, whereas the dangerous phases of this disease, and especially its fatal tendency, frequently result from supplementary invasion of the blood and tissues of the patient by streptococcus pyogenes. Thus he ascertained that streptococcus scarlatinæ is the micro-organism which is uniformly present and predominant in the

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mucous secretion of the tonsil of ordinary mild scarlatina; that in the nasal discharge of the disease this micro-organism is exceptionally, and in the ear-discharge only rarely, to be detected; and that in the blood and organs of fatal cases, where its presence in abundance might have been anticipated, streptococcus scarlatinæ is by no means universally found. On the other hand, streptococcus pyogenes was found by him to be seldom absent from scarlatina at any stage of this disease. Frequently it was present, in association with streptococcus scarlatinæ, in the tonsillar mucus of even uncomplicated benign cases at a very early stage of their attack; and in the nasal and aural discharges of the disease it abounded, to the exclusion almost of other micro-organisms. Finally, in the blood and organs of fatal scarlatina Dr. Gordon found streptococcus pyogenes commonly present—in circumstances, indeed, and under conditions, in the majority of cases, highly suggestive that death had resulted by the agency not of streptococcus scarlatinæ, but of this other and septicæmic micro-organism.

Other work by Dr. Gordon in 1900–01 on scarlatina has included study in general of the differential characters of various streptococci associated in this disease, in the course of which study he has dealt specially with those of them which he regards as essentially concerned with the clinical manifestations of the malady. Streptococcus scarlatinæ and streptococcus pyogenes he has subjected to the severest of known biological tests. Each of them, derived in turn from a variety of sources, has been passed by him through the bodies of a series of rodents, and very generally with the result that when recovered from the tissues of the last rodent of the series the particular streptococcus has been found to have retained its biological individuality altogether unimpaired.

One other observation by Dr. Gordon in this connection is of particular interest. He finds that whereas streptococcus pyogenes when inoculated into the mouse is, as a rule, fatal to that animal by general diffusion of the microbe throughout its tissues, streptococcus scarlatinæ is capable of producing a like effect while remaining wholly restricted to the site of inoculation. This observation would seem not only to afford indication of ready and fundamental distinction between the micro-organisms in question, but to give hope also of bacteriological differentiation in future of the disease scarlatina, with corresponding indications for satisfactory treatment, according as the attack is of simple nature or is of grave and complicated type.

ENTERIC FEVER AND BIOLOGY OF SOIL.

In view of belief long held by epidemiologists that the epidemicity of certain infectious diseases, more especially those apt to be waterborne, is governed by conditions independent of the human subject, investigations have for some years been undertaken by the Board of *soil* as a possible multiplying ground of particular pathogenic bacteria. The microbe to

which more particular attention has been given has been the typhoid bacillus, the accepted essential cause of enteric fever, since presumption has been strong that this micro-organism is above others prone, when distributed over soil along with sewage and other effete matter, to multiply on occasion by large amount and with much rapidity, while still preserving in its offspring its characteristic virulence. But the results so far of the laboratory experiments which have been undertaken have afforded indication less of soil conditions which conserve and multiply, than of soil conditions which inhibit and destroy, the typhoid bacillus. It has been found that though organically polluted, surface soils do, *when sterilised*, permit multiplication of this microbe, not any surface soils wherein the enteric fever micro-organism was brought in competition with the bacteria natural to the soil have afforded opportunity to this bacillus to maintain its existence for more than a few days.

In these circumstances, investigation in 1900-01 sought to ascertain—

(1.) The precise conditions which in a surface soil, elsewise favourable to the multiplication of the typhoid bacillus, determine its prompt extinction when placed therein in competition with the bacteria natural to the soil.

(2.) How far the hostility exhibited in the laboratory by surface soil microbes toward the typhoid bacillus is, under the natural conditions of open country, extended to other microbes of intestinal derivation ; to such micro-organisms, for instance, as are commonly far more abundant in sewage than the typhoid bacillus, and which, under the conditions of open country experiment, are much more readily identified and estimated in bulk than the enteric fever microbe.

(3.) What, in a given locality, the soil of which has long been habitually fouled by excremental matters and wherein enteric fever is endemic, is the result, as regards the bacterial quality of its deep soil water, of conflict in the upper layers of the soil between micro-organisms proper to the soil and intestinal bacteria with which such soil has been fouled ?

(a.) ANTAGONISM BETWEEN SOIL BACTERIA AND B. TYPHOSUS.

Dr. Sidney Martin's report (Appendix B, No. 4) relates to the first of these questions. He endeavoured at the outset to determine whether the extinction of the typhoid bacillus when in competition with other microbes in a surface soil otherwise favourable is due, on the one hand to exhaustion of nutriment in the soil in consequence of rapid multiplication of the numerous competing soil micro-organisms, or on the other hand is to be referred to special antagonism of chemical products of certain soil bacteria to the typhoid bacillus. A readily identifiable non-putrefactive microbe—bacillus ramificans—was isolated from soil, and pure cultures obtained. Having ascertained by preliminary

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experiments the existence of antagonism between this bacillus and the typhoid bacillus, sterilised surface soil from Chichester, and a dilute liquid medium containing peptone, were each inoculated respectively—with bacillus ramificans; with typhoid bacillus recently obtained from the human subject; and with both these micro-organisms, either at one and the same time, or after suitable intervals.

The media thus inoculated were then incubated, some at 37° C., others at 22° C., and every few days they were tested to determine, in the case of the double inoculation, the relative abundance of the two micro-organisms, and in the case of the single inoculations, the validity of the control experiments. Dr. Martin found that in the Chichester soil B. ramificans caused diminution of the typhoid bacillus in about twenty-six days, and produced its extinction in about 33 days. In the liquid medium similar diminution was apparent in 45 days, and extinction in 72 days. Further, in order to encourage a growth of B. typhosus, this bacillus was inoculated into ordinary peptone broth and incubated at 37° C., B. ramificans not being superadded to the broth until the typhoid bacillus had a start of four days. The result, however, hardly differed from the previous experiments: B. ramificans had obtained the mastery after 37 days, and the typhoid bacilli disappeared altogether after 52 days.

Dr. Martin now separated sterile filtrates from certain liquid media which for several weeks had supported, one a pure growth of B. ramificans, another a mixed growth of B. ramificans and B. typhosus. Both filtrates were inoculated from an active broth culture of the typhoid bacillus. The latter, however, in each instance had become extinct at the end of three days. In a further series of experiments nutrient media, of a kind favourable to the growth of the typhoid bacillus, were inoculated with Chichester surface soil, incubated for various periods, and then filtered. The filtrates, containing the chemical products of the numerous soil micro-organisms, proved in each instance fatal to the vitality of the typhoid bacillus. It is noteworthy that they likewise failed to permit growth of Gärtner's bacillus and bacillus coli.

(b.) LIFE OF SEWAGE MICRO-ORGANISMS IN SURFACE SOIL UNDER NATURAL CONDITIONS.

The second of the questions formulated above has been made (Appendix B, No. 5) the subject of careful study by Dr. Houston. On a country estate a plot of ground, 5 feet square, which had not been manured for at least six years, was selected. On three separate occasions fresh cesspool sewage was uniformly distributed over this plot:—in July, 12 gallons were applied, all in one day; for some five weeks in August and September the same quantity was distributed over the plot twice a week; and during some eight weeks in mid-winter fresh cesspool sewage was applied intermittently in the total amount of 60 gallons. In this way organic matter containing, as Dr. Houston ascertained by control experiment, a host of micro-organisms habitually abundant in

fresh sewage, was introduced into soil previously free from them.

In course of, and every few days for many weeks after, each treatment with sewage, portions of soil were removed (under comparable conditions and with precautions which Dr. Houston details) and were subjected to scrutiny. The object was to determine how long sewage micro-organisms—in particular streptococcus, B. coli, and B. enteritidis—were able to maintain their existence in the soil, and in what abundance they could be found there as time went on. It was to be expected that the results obtained after each watering, or series of waterings, with sewage would not be in all respects comparable, having regard to variations in season, temperature, and rainfall, and to necessary modifications of the conditions of experiment; and instructive indications of differences thus caused can be gathered from Dr. Houston's data. Taking the experience of the whole twelvemonths, however, Dr. Houston found that certain results were obtained time after time. Watering the soil with sewage containing micro-organisms in enormous number did not entail marked permanent addition to the total number of bacteria in the soil plot. Only for a comparatively few days after receiving the sewage did the soil show conspicuous increase in its total bacterial contents, along with diminution in the proportion of its spore-bearing micro-organisms to the total bacteria. It was evident that the soil bacteria, as a class, readily gained the mastery over the sewage bacteria.

As regards sewage micro-organisms of particular kinds, Dr. Houston found that microbes of the streptococcus class, which in previous researches he has shown to be characteristically abundant in fresh sewage, were almost at once killed in the soil. Microbes capable of producing gas in gelatine shake-culture, constantly present in cesspool sewage, showed in the soil no tendency to increase after the first few days, and thereafter diminished. Like diminution occurred in microbes capable of developing indol in broth culture at 37° C. On the other hand the well-known ability of the sporing B. enteritidis to maintain itself in soil was again illustrated in these experiments, although it is noteworthy that the addition of sewage to the soil plot failed to bring about as much increase as might have been anticipated in the total number of spores of this microbe. The facts as regards persistence of B. coli are of particular interest in view of the association of this microbe with B. typhosus. Bacillus coli which is "typical," in the sense of responding to all the series of tests to which this micro-organism, when of recent intestinal origin, is recognised to respond, had, upon the whole, a short life in the soil. But we have now come to recognise as almost certain that this microbe in diverse environments outside the animal body, is apt to undergo modifications in its cultural characters, and that forms atypical, in that they fail to respond to certain of the tests, are

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none the less derivatives, more or less recent, of the "typical" bacillus. For many weeks after each watering of his soil plot with sewage, Dr. Houston found evidence of the presence of these varieties (as they may here be termed) of B. coli. Although in each instance they showed a general tendency to decrease in numbers, and sometimes appeared to have become extinct as time went on, it is instructive to note that on several occasions, whether as a result of seasonal or other conditions, a distinct increase took place, and that, among the forms of B. coli which were separated during this renewal of vitality, some were in all cultural respects "typical." Such typical forms were obtained in one instance on the fifty-sixth day, and in another on the eightieth day after the last watering with sewage. A parallel series of experiments made by Dr. Houston, in London, with soil kept in specially constructed boxes and watered at intervals with London crude sewage, yielded a series of results very similar to those obtained under more natural conditions in the country.

(c.) DETECTION OF SEWAGE MICRO-ORGANISMS IN DEEP SOIL WATER.

The third of the above questions—*i.e.*, the bacterial quality of deep soil water as influenced by contamination, excremental and other, of the surface soil in areas prone to enteric fever—has been likewise investigated (Appendix B, No. 6), by Dr. Houston, who, for reasons which will be apparent to readers of my report of last year, has selected Chichester as a locality where enteric fever is endemic, and where the conditions of soil-fouling could be considered to answer the required purpose. Chichester wells are sunk in coarse gravel overlying the clay of the London and Reading beds, and are so constructed as to permit lateral flow of soil water through them. In making his choice of wells, Dr. Houston selected those which are covered over: fourteen wells were examined, most of which are situate in parts of the town that, as a result of Dr. Thomson's enquiries, may be termed endemic enteric fever areas. Water from several of these wells was examined on more than one occasion. In all, thirty samples were tested, each as regards its chemical purity, the total number of bacteria, and the presence and relative abundance respectively of bacteria capable of producing gas in gelatine shake-culture, of B. coli and allied forms, of B. typhosus, of spores of B. enteritidis, and of streptococci. Apart from certain inequalities in the amount of chlorine, none of these samples yielded chemical results likely to give rise to suspicion of organic pollution. Most of the waters indeed would, on chemical data, be judged to be of somewhat exceptional purity. And if reliance were placed on determination of the total number of microbes, the majority would be considered pure. For example, nine contained less than 15, and other five less than 100 bacteria per cubic centimetre. Only in two or three was the total number strikingly large :—*e.g.* above 400 per cubic centimetre.

Twenty-two out of the above thirty samples failed to produce development of gas in gelatine shake-culture, even when (by the

filter-brushing method) as much as 100 cc. of the sample was employed:—of the remaining eight, two gave a positive result when no more than 10 cc. was used. None of the thirty samples gave indication of presence of spores of B. enteritidis when as little was employed as 10 cc.

The results obtained with respect to the presence of B. coli and allied forms were striking. And here be it noted that lest there should be any doubt as to his reasons for judging a particular micro-organism as, or as not, allied to B. coli, the results of testing in diverse ways every microbe which presented *primâ facie* resemblance to B. coli have been recorded in detail by Dr. Houston. Out of the 30 well-waters, no less than 22 showed the presence of coli-like microbes in 100 cc. or less. Twelve waters showed these micro-organisms in 10 cc.; no less than six yielded coli-like microbes in 0·1 cc. As regards samples collected from the same wells but on different dates, it is noteworthy that B. coli or allied forms were sometimes absent from every sample, but in other cases it was present at one time and absent at another. Samples showing relative abundance of coli-like microbes in several instances had also shown an unusually large total number of bacteria. But this was not always the case, and in one instance B. coli was detected in 10 cc., while the total number of bacteria per cc. was only fourteen. The typhoid bacillus was not detected in any of the thirty well-waters. All microbes presenting *primâ facie* resemblance to B. coli or to B. typhosus were tested as regards "Widal's" re-action, and Dr. Houston records some interesting positive results in the case of certain coli-like bacteria.

The results with regard to streptococci are of interest in view of the comparative rapidity with which micro-organisms of this class when introduced along with sewage into water or surface soil have been shown to disappear. No micro-organism that could with certainty be placed in the streptococcus class was found in 10 cc. of twenty-five of the well-waters; in 10 cc. of each of the remaining five, streptococcus was present. Three of these five had contained an excessive total number of bacteria; the other two were less conspicuous in this respect. All five had shown coli-like microbes in 10 cc.

The indication afforded by these experiments that the antagonism to bacteria of recent intestinal outcome which is exhibited by surface soil is not encountered, at any rate to the same extent, in deep soil water such as that at Chichester, is valuable, and is particularly suggestive in relation to the difficult problem which the Medical Department has now for some time been pursuing; that of ascertaining the nature of the conditions under which the typhoid-bacillus is capable of maintaining itself outside the animal body.

SPECIFIC MICROBES AND COCKLES.

In sequence to demonstration of the ability of oysters gathered from sewage befouled foreshores to convey to persons consuming

them the infection of enteric fever, representation has arisen that other shell fish, more particularly cockles and mussels, are, in like manner and in like conditions, also capable of disseminating this disease. A *priori*, as for instance in the fact that these other shell fish are not usually eaten raw, there were gronnds for regarding cockles and mussels as far less likely than oysters to act as agents in conveying enteric fever; but in view of the circumstantial evidence adduced in particular instances as to association of outbreaks of this disease with consumption of the shell fish in question, some experimental testing of the validity of these allegations was obviously desirable.

In the report of your Medical Officer for last year Dr. Klein gave account of bacterioscopic examination by him of cockles from foreshores obviously polluted by liquid refuse, in which he showed that these molluscs may, on occasion, take up and retain within their bodies bacteria characteristic of sewage. During 1900–1 he has extended (Appendix B, No. 7) his observations to the ability, under laboratory conditions, of cockles and mussels to afford nidus and multiplying ground for particular pathogenic microbes, and further has tested the efficiency of certain so-called "cooking" processes in destroying the vitality of infection germs which these molluscs may happen to contain.

Dr. Klein finds that both cockles and mussels readily take up, from sea water in which the microbes are present in gross amount, the bacillus of enteric fever and the vibrio of cholera, and that they can retain in their interior these germs of disease for some days after they have been withheld from further contamination. As regards the typhoid bacillus indeed, and so far as laboratory conditions are concerned, he obtained indication that cockles may on occasion serve as multiplying ground for this specific polluting agent. The suspicions thus engendered of the cockle as especially undesirable when it has been subjected to sustained exposure to the excreta of enteric fever, is by no means allayed by Dr. Klein's further account of certain quasi "cooking" procedures to which he submitted his experimentally infected molluscs. He found that, dealing with the infected shell-fish in bulk, application of boiling water, though it sufficed to kill microbes in the molluscs on the surface of the mass, was not necessarily germicidal to the bacteria within the bodies of those situated in its lower layers.

DESTRUCTION OF RATS ON SHIPBOARD BY CARBONIC OXIDE GAS.

Wide extension of plague to ports abroad, along with growing suspicion of ship-borne rats as likely agents in diffusion of this disease, raised question as to means for dealing in satisfactory fashion with rat-infested vessels arriving from plague-infected places. It was foreseen that such vessels, more especially if the rats on board them were already plague-infected, were not unlikely to become sources of danger to this country; and that therefore, the extermination of rats on ships newly arriving from plague-infected ports might be desirable. No means, however,

MEDICAL OFFICER'S REPORT.

were to hand for effecting this with any certainty, and without damage to the vessel's cargo, unless at expenditure of time such as, in the interests of trade, was likely to prove prohibitive. Accordingly a rat destroying gas was sought which could, immediately on arrival of a ship, and before her cargo was broken, be made in a short while to pervade the interior of the vessel in a way effectually to destroy all rats without in any sense injuring cargo; and which could then, in an equally short while, be withdrawn again so as to allow the vessel, after practically no delay at all, to enter dock and discharge her merchandise. In the circumstances, carbonic oxide presented itself as a gas fulfilling the conditions required, and as possessing moreover, the advantage of capacity for stupefying and killing rats without first alarming them in a way to cause them to flee ashore in endeavour to avoid the process contrived for their destruction.

Dr. Haldane reports in Appendix B, No. 8, the results obtained by him in preliminary experiment on employment of carbonic oxide as a means of destroying rats on plague-infected vessels. The method of carbonic oxide fumigation devised and adopted by Dr. Haldane has, so far as an empty vessel of small size is concerned, proved wholly satisfactory, and he is now investigating the applicability of his method of rat destruction to vessels of large size, fully loaded, and retaining their cargoes altogether undisturbed.

ELIMINATION OF EXTRANEOUS MICRO-ORGANISMS FROM VACCINE LYMPH.

Concurrently with routine testings by the Board's Bacteriologists of the efficiency of the glycerine process employed at the Lymph Laboratories in eliminating, from successive series of lymphs maturing there for issue, the extraneous or other undesirable micro-organisms commonly associated with lymph as collected from the calf, much work has been done in extension of our knowledge of these bacteria of vaccine lymph, and of methods for their detection, isolation, and identification. Further, with the object of curtailing, if practicable, the costliness in time of the glycerinating process—for the purpose, that is, of securing prompt destruction in the lymph of all extraneous micro-organisms, without detriment later to its proper activity—close study has been given to a number of the conditions of lymph glycerination, for the discovery and better understanding of those of them that are essential to and which govern successful practice of the process. Finally, in the economic interests of the Board's lymph establishment, particularly as regards expenditure of time and labour, search has been made for agencies other than glycerine more competent than that medium to eliminate from the lymph extraneous micro-organisms, and free also from that ultimately deleterious effect on the activity of vaccine which is apt to result from long sustained association of the lymph with the glycerine.

Detailed account is given in Appendix C. of these various investigatory procedures, in a series of reports by Dr. Blaxall, Mr. Fremlin, and Dr. Green. Generally, the results of the work

of these observers goes to show that the methods adopted by the Board for securing, by means of glycerine, a lymph of uniformly satisfactory quality in public vaccination, leave, save as to time occupied in applying them and uncertainty in the "keeping quality" of the lymph, little to be desired. In other directions, too, their work is encouraging. It affords prospect of an agency in lymph manufacture not only more potent than glycerine as a germicide of extraneous micro-organisms, but also considerably less deleterious than that substance in later antagonistic influence on the activity of the vaccine lymph after it has passed from the Board's establishment into the hands of the Public Vaccinators.

I have the honour to be,

Sir,

Your obedient Servant,

W. H. POWER.

APPENDICES.

APPENDIX A.

App. A, No. 1.

Digest of Vaccination Officers' Returns, 1898.

No. 1.

Digest of the **Vaccination Officers' Returns** with regard to Children whose Births were registered in the Year 1898.

The following is a summary of the twenty-seventh annual return under the Vaccination Act, 1871:—Of 923,059 births returned to the Board by the several vaccination officers in England and Wales as registered during the year 1898, the number which, at the time the return was made, had been registered as successfully vaccinated was 562,737 (being almost 61·0 per cent. of the whole) and the number registered as having died unvaccinated was 110,912 (or 12·0 per cent. of the whole). Of the remaining 249,410 children, 3,232 (or 0·35 per cent. of the whole) had been registered as insusceptible of vaccination; 4 cases as having contracted small-pox; 16,921 (or 1·8 per cent.) as having their vaccination postponed by medical certificate; and 47,423 (or 5·1 per cent.) in respect of whom certificates of conscientious objection were received; leaving 181,830 (or 19·7 per cent.) as "removed," "not to be traced," or otherwise unaccounted for. If from the 923,059 births returned by these officers deduction be made of the deaths that took place without vaccination, it appears that, of the surviving 812,147 children, there were registered at the time of the return 69·3 per cent. as successfully vaccinated; 0·4 per cent. as either insusceptible of vaccination, or as having had small-pox; 2·1 per cent. as under medical certificate of postponement; and 5·8 per cent. in respect of whom certificates of conscientious objection to vaccination had been obtained; leaving 22·4 per cent. as at that time still unaccounted for as regards vaccination.

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Digest of Vaccination Officers' Returns, 1898.

The proportion of cases unaccounted for in the metropolitan returns for 1898 is 31·2 per cent.; in the provincial returns, 19·6. Of the registered births in the twenty-seven years, 1872–98, the proportion not finally accounted for in regard to vaccination (including cases postponed) in each year respectively has been as follows:—

—	Metropolis.	Rest of England.	—	Metropolis.	Rest of England.
1872	8·8	4·5	1886	7·8	6·1
1873	8·7	4·2	1887	9·0	6·7
1874	8·8	4·1	1888	10·3	8·2
1875	9·3	3·8	1889	11·6	9·6
1876	6·5	4·0	1890	13·9	10·9
1877	7·1	4·1	1891	16·4	12·9
1878	7·1	4·3	1892	18·4	14·3
1879	7·8	4·5	1893	18·2	15·7
1880	7·0	4·5	1894	20·6	19·0
1881	5·7	4·3	1895	24·9	19·8
1882	6·6	4·5	1896	26·4	22·3
1883	6·5	4·9	1897	29·1	21·6
1884	6·8	5·3	1898	33·0	19·6
1885	7·0	5·5			

———	Metropolis.	Rest of England.
Average of five years 1873–77 ...	8·1	4·1
„ „ 1878–82 ...	6·8	4·4
„ „ 1883–87 ...	7·4	5·7
„ „ 1888–92 ...	14·1	11·2
„ „ 1893–97 ...	23·9	19·7

In 1898 the proportion of cases unaccounted for, after deduction of the postponed cases, in the Metropolis and in the rest of England, was 31·2 and 17·8 per cent. respectively.

For purposes of comparison, an addition has been made to the tables, showing as regards each period of five years, from 1873 to 1897, the proportion to the entire number of births registered, of the cases unaccounted for in the Metropolis and the rest of England and Wales respectively.

APP. A, No.

Digest of Vaccination Officers' Returns, 189

—	Returns, 1898. Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Number in respect of whom Certificates of conscientious objection have been received.	Died Unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of births.	Children remaining "unaccounted for" when the Returns for the several years were received. Total number for the years 1893-97.	Average per cent. for the years 1893-97.
ENGLAND AND WALES.	923,059	562,737	3,232	4	47,423	110,912	16,921	181,830	21·5	926,772	20·3
Ditto (excluding Metropolitan Unions).	790,274	491,329	2,761	4	45,609	95,611	14,596	140,364	19·6	767,645	19·7
METROPOLITAN UNIONS.	132,785	71,408	471	..	1,814	15,301	2,325	41,466	33·0	159,127	23·9
COUNTIES.											
ENGLAND:											
Bedford	4,201	626	1	..	687	596	38	2,253	54·5	15,106	70·6
Berks	7,029	4,527	23	..	193	736	120	1,430	22·1	4,407	12·2
Bucks	4,346	2,606	8	1	568	421	63	679	17·1	6,196	27·1
Cambridge ..	5,062	3,791	16	..	121	490	128	516	12·7	2,521	9·5
Chester	21,548	17,259	72	..	323	2,627	306	961	5·9	6,947	6·5
Cornwall ..	7,892	4,957	14	..	110	1,022	172	1,617	22·7	10,475	25·2
Cumberland ..	7,549	5,086	17	..	330	800	236	1,080	17·4	6,724	17·0
Derby	14,791	6,667	30	..	454	1,923	287	5,430	38·7	26,021	35·6
Devon	16,223	11,765	50	..	226	1,593	506	2,083	16·0	7,493	9·0
Dorset	4,854	3,440	5	..	676	334	80	319	8·2	3,870	15·5
Durham ..	40,241	25,708	197	..	1,152	5,711	964	6,509	18·6	33,303	17·2
Essex	28,527	15,126	77	..	907	2,919	872	8,626	33·3	27,071	20·3
Gloucester ..	17,167	7,391	51	..	1,748	1,901	487	5,589	35·4	26,377	31·3
Hereford ..	2,809	2,135	9	..	65	260	62	278	12·1	1,307	8·6
Hertford ..	7,039	4,425	26	..	415	635	110	1,428	21·8	7,145	20·3
Huntingdon ..	1,198	991	7	..	36	93	10	61	5·9	379	6·0
Kent (extra-metropolitan).	22,690	16,305	98	..	838	2,348	475	2,626	13·7	14,732	13·1
Lancaster ..	133,448	82,908	446	..	9,168	18,531	2,238	20,157	16·8	134,700	20·4
Leicester ..	12,878	1,228	4	..	3,661	1,874	39	6,072	47·5	44,621	72·0
Lincoln	13,207	7,211	49	..	2,204	1,753	219	1,771	15·1	14,947	22·4
Middlesex (ex. metropolitan).	19,025	11,262	95	..	276	1,960	400	5,032	28·6	15,584	18·4
Monmouth ..	10,301	6,888	33	..	376	1,085	326	1,593	18·6	7,924	15·6
Norfolk	12,565	6,828	21	..	2,312	1,655	120	1,629	13·9	17,689	27·2
Northampton ..	9,741	2,085	6	..	3,242	1,197	49	3,162	33·0	27,747	58·4
Northumberland	18,333	11,513	64	..	407	2,494	312	3,543	21·0	13,287	15·1

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Northampton ..	9,741	2,085	6	..	3,242	1,197	49	3,162	33·0	27,747	58·4
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COUNTIES—*cont.*											
ENGLAND—*cont.*											
Nottingham ..	17,878	8,040	43	..	3,324	2,508	344	4,619	27·8	24,644	28·2
Oxford	4,639	3,227	11	..	522	354	57	458	11·1	4,412	17·8
Rutland ..	460	387	2	..	15	39	2	15	3·7	138	5·3
Salop	6,905	5,477	7	..	96	675	136	514	9·4	3,732	10·7
Somerset ..	11,820	7,387	37	1	794	1,089	467	2,045	21·3	15,018	21·9
Southampton ..	19,125	14,387	97	..	521	1,790	285	2,045	12·2	8,944	9·5
Stafford	36,200	20,511	121	..	1,133	5,032	578	8,825	26·0	41,682	23·9
Suffolk	9,642	6,554	16	..	508	987	135	1,442	16·4	6,642	13·3
Surrey (extra-metropolitan).	16,234	10,120	56	..	447	1,637	394	3,580	24·5	15,222	19·6
Sussex	13,728	8,911	44	..	860	1,328	255	2,330	18·8	13,480	19·5
Warwick ..	27,755	17,004	106	..	593	3,813	343	5,896	22·5	24,943	19·3
Westmorland ..	1,541	1,320	1	..	41	122	17	40	3·7	320	3·9
Wilts	6,771	2,911	14	..	1,266	548	234	1,798	30·0	10,328	30·2
Worcester ..	19,607	14,187	68	..	451	2,119	301	2,481	14·2	10,843	11·4
York, E. Riding	13,412	9,469	58	..	619	1,650	159	1,457	12·0	7,837	12·1
York, N. Riding	10,889	7,829	44	2	697	1,229	215	873	10·0	6,503	12·3
York, W. Riding	78,468	49,623	528	..	3,985	9,866	967	13,519	18·5	79,804	20·6
WALES:											
Anglesey ..	894	780	..	..	8	61	16	29	5·0	204	4·7
Brecknock ..	1,574	1,170	3	..	18	119	45	219	16·8	781	10·1
Cardigan ..	1,517	1,269	..	..	13	155	19	61	5·3	510	6·6
Carmarthen ..	3,991	3,432	1	..	6	431	50	71	3·0	810	3·9
Carnarvon ..	3,420	2,637	5	..	6	421	70	281	10·3	1,135	6·9
Denbigh ..	3,003	2,469	4	..	11	347	36	136	5·7	725	4·9
Flint	2,468	2,034	6	..	6	264	62	96	6·4	1,020	8·3
Glamorgan ..	29,342	22,637	65	..	170	3,448	641	2,381	10·3	8,783	6·1
Merioneth ..	1,842	1,287	..	..	5	209	48	293	18·5	442	5·2
Montgomery ..	1,679	1,424	3	..	10	139	28	75	6·1	416	5·0
Pembroke ..	2,225	1,770	1	..	4	227	63	160	10·0	771	6·9
Radnor	591	348	1	..	5	46	10	181	32·3	985	38·1

…OPOLITAN …NIONS.	Returns, 1898. Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Number in respect of whom Certificates of conscientious objection have been received.	Died unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of births.	Children remaining "unaccounted for" when the Returns for the several Years were received. Total number for the Years 1893–97.	Average percentage for the Years 1893–97.
…reen	4,805	968	..	..	11	615	44	3,167	66·8	*16,256*	*68·2*
…ell	7,441	3,578	17	..	86	788	192	2,780	40·0	*10,251*	*27·3*
.. .. ..	2,333	1,662	17	..	36	250	29	339	15·8	*1,613*	*12·0*
.. .. ..	4,312	3,171	23	..	90	453	78	497	13·3	*3,053*	*8·9*
St., Hanover	2,493	1,973	14	..	70	228	23	185	8·3	*721*	*5·3*
…t., in the East	2,102	1,186	2	..	6	187	..	721	34·3	*2,108*	*21·2*
…, and St. George	1,027	578	3	..	8	112	22	304	31·7	*1,058*	*19·8*
…h	5,626	3,947	19	..	113	693	154	700	15·2	*2,194*	*7·7*
.. .. ..	7,286	2,703	24	..	79	988	78	3,414	47·9	*21,621*	*61·5*
…smith	3,031	2,271	18	..	56	321	65	300	12·0	..*	..*
…ad	1,517	1,133	13	..	27	138	33	173	13·6	*610*	*8·2*
.. .. ..	4,755	2,077	22	..	35	572	151	1,898	43·1	*4,682*	*19·3*
.. .. ..	9,478	5,422	44	..	103	1,068	251	2,590	30·0	*9,290*	*19·0*
…on	3,651	2,728	18	..	55	413	19	418	12·0	*2,040*	*11·1*
.. .. ..	9,275	5,290	37	..	138	1,106	65	2,630	29·1	*11,544*	*24·7*
…n	2,782	1,695	9	..	75	304	10	689	25·1	*2,432*	*19·1*
…City of	468	296	2	..	35	51	2	82	17·9	*359*	*13·1*
…ne	4,103	2,962	20	..	26	382	103	610	17·4	*3,418*	*15·8*
Old Town ..	4,343	875	3	..	24	476	..	2,965	68·3	*11,987*	*57·1*
.. .. ..	4,744	2,698	13	..	64	487	17	1,465	31·2	*5,272*	*21·4*
…on	2,966	2,223	16	..	75	290	34	328	12·2	*1,426*	*9·5*
…St.	6,861	3,549	29	..	104	767	225	2,187	35·2	*5,734*	*16·3*
.. .. ..	5,914	1,286	5	..	13	863	30	3,717	63·4	*9,306*	*31·4*
…St.	7,047	3,778	18	..	65	951	10	2,225	31·7	*6,981*	*19·4*
…h	4,295	744	2	..	16	595	132	2,806	68·4	*9,595*	*43·9*
.. .. ..	1,913	719	5	..	9	260	8	912	48·1	*3,391*	*34·2*
.. .. ..	416	257	4	..	6	50	13	86	23·8	*374*	*15·4*
…rth and Clap-	10,396	5,853	44	..	185	1,152	484	2,678	30·4	*9,434*	*19·0*
…ter	706	526	1	..	13	56	3	107	15·6	*791*	*19·9*
…pel	3,129	2,477	7	..	34	275	30	306	10·7	*895*	*5·7*
…	3,570	2,774	22	..	157	410	20	187	5·8	*762*	*4·2*
	132,786	71,408	471	..	1,814	15,301	2,325	41,466	33·0	*159,127*	*23·9*

…Union was constituted on 26th March, 1899. It previously formed part of Fulham.

of these observers goes to show that the methods adopted by the Board for securing, by means of glycerine, a lymph of uniformly satisfactory quality in public vaccination, leave, save as to time occupied in applying them and uncertainty in the "keeping quality" of the lymph, little to be desired. In other directions, too, their work is encouraging. It affords prospect of an agency in lymph manufacture not only more potent than glycerine as a germicide of extraneous micro-organisms, but also considerably less deleterious than that substance in later antagonistic influence on the activity of the vaccine lymph after it has passed from the Board's establishment into the hands of the Public Vaccinators.

I have the honour to be,

Sir,

Your obedient Servant,

W. H. POWER.

APPENDICES.

APPENDIX A.

APP. A, No.

Digest of Vaccination Officers' Returns, 1898.

No. 1.

DIGEST of the VACCINATION OFFICERS' RETURNS with regard to Children whose Births were registered in the Year 1898.

The following is a summary of the twenty-seventh annual return under the Vaccination Act, 1871:—Of 923,059 births returned to the Board by the several vaccination officers in England and Wales as registered during the year 1898, the number which, at the time the return was made, had been registered as successfully vaccinated was 562,737 (being almost 61·0 per cent. of the whole) and the number registered as having died unvaccinated was 110,912 (or 12·0 per cent. of the whole). Of the remaining 249,410 children, 3,232 (or 0·35 per cent. of the whole) had been registered as insusceptible of vaccination; 4 cases as having contracted small-pox; 16,921 (or 1·8 per cent.) as having their vaccination postponed by medical certificate; and 47,423 (or 5·1 per cent.) in respect of whom certificates of conscientious objection were received; leaving 181,830 (or 19·7 per cent.) as "removed," "not to be traced," or otherwise unaccounted for. If from the 923,059 births returned by these officers deduction be made of the deaths that took place without vaccination, it appears that, of the surviving 812,147 children, there were registered at the time of the return 69·3 per cent. as successfully vaccinated; 0·4 per cent. as either insusceptible of vaccination, or as having had small-pox; 2·1 per cent. as under medical certificate of postponement; and 5·8 per cent. in respect of whom certificates of conscientious objection to vaccination had been obtained; leaving 22·4 per cent. as at that time still unaccounted for as regards vaccination.

App. A, No. 1.

Digest of Vaccination Officers' Returns, 1898.

The proportion of cases unaccounted for in the metropolitan returns for 1898 is 31·2 per cent.; in the provincial returns, 19·6. Of the registered births in the twenty-seven years, 1872–98, the proportion not finally accounted for in regard to vaccination (including cases postponed) in each year respectively has been as follows:—

—	Metropolis.	Rest of England.	—	Metropolis.	Rest of England.
1872	8·8	4·5	1886	7·8	6·1
1873	8·7	4·2	1887	9·0	6·7
1874	8·8	4·1	1888	10·3	8·2
1875	9·3	3·8	1889	11·6	9·6
1876	6·5	4·0	1890	13·9	10·9
1877	7·1	4·1	1891	16·4	12·9
1878	7·1	4·3	1892	18·4	14·3
1879	7·8	4·5	1893	18·2	15·7
1880	7·0	4·5	1894	20·6	19·0
1881	5·7	4·3	1895	24·9	19·8
1882	6·6	4·5	1896	26·4	22·3
1883	6·5	4·9	1897	29·1	21·6
1884	6·8	5·3	1898	33·0	19·6
1885	7·0	5·5			

———	Metropolis.	Rest of England.
Average of five years 1873–77 ...	8·1	4·1
" " 1878–82 ...	6·8	4·4
" " 1883–87 ...	7·4	5·7
" " 1888–92 ...	14·1	11·2
" " 1893–97 ...	23·9	19·7

In 1898 the proportion of cases unaccounted for, after deduction of the postponed cases, in the Metropolis and in the rest of England, was 31·2 and 17·8 per cent. respectively.

For purposes of comparison, an addition has been made to the tables, showing as regards each period of five years, from 1873 to 1897, the proportion to the entire number of births registered, of the cases unaccounted for in the Metropolis and the rest of England and Wales respectively.

—	Returns, 1898.									Children remaining "unaccounted for" when the Returns for the several years were received.	
	Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Number in respect of whom Certificates of conscientious objection have been received.	Died Unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of births.	Total number for the years 1893-97.	Average per cent. for the years 1893-97.
ENGLAND AND WALES.	923,059	562,737	3,232	4	47,423	110,912	16,921	181,830	21·5	926,772	20·3
Ditto (excluding Metropolitan Unions).	790,274	491,329	2,761	4	45,609	95,611	14,596	140,364	19·6	767,645	19·7
METROPOLITAN UNIONS.	132,785	71,408	471	..	1,814	15,301	2,325	41,466	33·0	159,127	23·9
COUNTIES.											
ENGLAND:											
Bedford	4,201	626	1	..	687	596	38	2,253	54·5	15,106	70·6
Berks	7,029	4,527	23	..	193	736	120	1,430	22·1	4,407	12·2
Bucks	4,346	2,606	8	1	568	421	63	679	17·1	6,196	27·1
Cambridge ..	5,062	3,791	16	..	121	490	128	516	12·7	2,521	9·5
Chester	21,548	17,259	72	..	323	2,627	306	961	5·9	6,947	6·5
Cornwall ..	7,892	4,957	14	..	110	1,022	172	1,617	22·7	10,475	25·2
Cumberland ..	7,549	5,086	17	..	330	800	236	1,080	17·4	6,724	17·0
Derby	14,791	6,667	30	..	454	1,923	287	5,430	38·7	26,021	35·6
Devon	16,223	11,765	50	..	226	1,593	506	2,083	16·0	7,493	9·0
Dorset	4,854	3,440	5	..	676	334	80	319	8·2	3,870	15·5
Durham ..	40,241	25,708	197	..	1,152	5,711	964	6,509	18·6	33,303	17·2
Essex	28,527	15,126	77	..	907	2,919	872	8,626	33·3	27,071	20·3
Gloucester ..	17,167	7,391	51	..	1,748	1,901	487	5,589	35·4	26,377	31·3
Hereford ..	2,809	2,135	9	..	65	260	62	278	12·1	1,307	8·6
Hertford ..	7,039	4,425	26	..	415	635	110	1,428	21·8	7,145	20·3
Huntingdon ..	1,198	991	7	..	36	93	10	61	5·9	379	6·0
Kent (extra-metropolitan).	22,690	16,305	98	..	838	2,348	475	2,626	13·7	14,732	13·1
Lancaster ..	133,448	82,908	446	..	9,168	18,531	2,238	20,157	16·8	134,700	20·4
Leicester ..	12,878	1,228	4	..	3,661	1,874	39	6,072	47·5	44,621	72·0
Lincoln	13,207	7,211	49	..	2,204	1,753	219	1,771	15·1	14,947	22·4
Middlesex (ex. metropolitan).	19,025	11,262	95	..	276	1,960	400	5,032	28·6	15,584	18·4
Monmouth ..	10,301	6,888	33	..	376	1,085	326	1,593	18·6	7,924	15·6
Norfolk	12,565	6,828	21	..	2,312	1,655	120	1,629	13·9	17,689	27·2
Northampton ..	9,741	2,085	6	..	3,242	1,197	49	3,162	33·0	27,747	58·4
Northumberland	18,333	11,513	64	..	407	2,494	312	3,543	21·0	13,287	15·1

App. A, No. 1.

Digest of Vaccination Officers' Returns, 1898.

—	Returns, 1898.									Children remaining "unaccounted for" when the Returns for the several years were received.	
	Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Number in respect of whom Certificates of conscientious objection have been received.	Died Unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases, postponed), per cent. of births.	Total number for the years 1893-97.	Average per cent. for the years 1893-97.
COUNTIES—*cont.*											
ENGLAND—*cont.*											
Nottingham ..	17,878	8,040	43	..	2,324	2,508	344	4,619	27·8	24,644	28·2
Oxford	4,629	3,227	11	..	522	354	57	458	11·1	4,412	17·8
Rutland ..	460	387	2	..	15	39	2	15	3·7	138	5·3
Salop	6,905	5,477	7	..	96	675	136	514	9·4	3,732	10·7
Somerset ..	11,820	7,387	37	1	794	1,089	467	2,045	21·3	15,018	21·9
Southampton ..	19,125	14,387	97	..	521	1,790	285	2,045	12·2	8,944	9·5
Stafford	36,200	20,511	121	..	1,133	5,032	578	8,825	26·0	41,682	23·9
Suffolk	9,642	6,554	16	..	508	987	135	1,442	16·4	6,642	13·3
Surrey (extra-metropolitan).	16,234	10,120	56	..	447	1,637	394	3,580	24·5	15,222	19·6
Sussex	13,728	8,011	44	..	860	1,328	255	2,330	18·8	13,480	19·5
Warwick ..	27,755	17,004	106	..	593	3,813	343	5,896	22·5	24,943	19·3
Westmorland ..	1,541	1,320	1	..	41	122	17	40	3·7	320	3·9
Wilts	6,771	2,911	14	..	1,266	548	234	1,798	30·0	10,326	30·2
Worcester ..	19,607	14,187	68	..	451	2,119	301	2,481	14·2	10,843	11·1
York, E. Riding	13,412	9,469	58	..	619	1,650	159	1,457	12·0	7,837	12·1
York, N. Riding	10,889	7,829	44	2	697	1,229	215	873	10·0	6,503	12·3
York, W. Riding	78,468	49,623	528	..	3,965	9,866	967	13,519	18·5	79,804	20·6
WALES:											
Anglesey ..	894	780	..	..	8	61	16	29	5·0	204	4·7
Brecknock ..	1,574	1,170	3	..	18	119	45	219	16·8	781	10·1
Cardigan ..	1,517	1,269	..	..	13	155	19	61	5·3	510	6·6
Carmarthen ..	3,991	3,432	1	..	6	431	50	71	3·0	810	3·9
Carnarvon ..	3,420	2,637	5	..	6	421	70	281	10·3	1,135	6·9
Denbigh ..	3,003	2,469	4	..	11	347	36	136	5·7	725	4·9
Flint	2,468	2,034	6	..	6	264	62	96	6·4	1,020	8·3
Glamorgan ..	29,342	22,637	65	..	170	3,448	641	2,381	10·3	8,783	6·1
Merioneth ..	1,842	1,287	..	..	5	209	48	293	18·5	442	5·2
Montgomery ..	1,679	1,424	3	..	10	139	28	75	6·1	416	5·0
Pembroke ..	2,225	1,770	1	..	4	227	63	160	10·0	771	6·9
Radnor	591	348	1	..	5	46	10	181	32·3	985	38·1

METROPOLITAN UNIONS.	RETURNS, 1898. Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Number in respect of whom Certificates of conscientious objection have been received.	Died unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of births.	Children remaining "unaccounted for" when the Returns for the several Years were received. *Total number for the Years 1893–97.*	*Average percentage for the Years 1893–97.*
Bethnal Green	4,805	968	..	..	11	615	44	3,167	66·8	*16,256*	*68·2*
Camberwell	7,441	3,578	17	..	86	788	192	2,780	40·0	*10,251*	*27·3*
Chelsea	2,333	1,662	17	..	36	250	29	339	15·8	*1,613*	*12·0*
Fulham	4,312	3,171	23	..	90	453	78	497	13·3	*3,053*	*8·9*
George, St., Hanover Square.	2,493	1,973	14	..	70	228	23	185	8·3	*721*	*5·3*
George, St., in the East	2,102	1,186	2	..	6	187	..	721	34·3	*2,108*	*21·2*
Giles, St., and St. George	1,027	578	3	..	8	112	22	304	31·7	*1,058*	*19·8*
Greenwich	5,626	3,947	19	..	113	693	154	700	15·2	*2,124*	*7·7*
Hackney	7,286	2,703	24	..	79	988	78	3,414	47·9	*21,621*	*61·5*
Hammersmith	3,031	2,271	18	..	56	321	65	300	12·0	..*	..*
Hampstead	1,517	1,133	13	..	27	138	33	173	13·6	*610*	*8·2*
Holborn	4,755	2,077	22	..	35	572	151	1,898	43·1	*4,682*	*19·3*
Islington	9,478	5,422	44	..	103	1,068	251	2,590	30·0	*9,290*	*19·0*
Kensington	3,651	2,728	18	..	55	413	19	418	12·0	*2,040*	*11·1*
Lambeth	9,275	5,299	37	..	138	1,106	65	2,630	29·1	*11,544*	*24·7*
Lewisham	2,782	1,695	9	..	75	304	10	689	25·1	*2,432*	*19·1*
London, City of	468	296	2	..	35	51	2	82	17·9	*359*	*13·1*
Marylebone	4,103	2,962	20	..	26	382	103	610	17·4	*3,418*	*15·8*
Mile End Old Town ..	4,343	875	3	..	24	476	..	2,965	68·3	*11,987*	*57·1*
Olave, St.	4,744	2,698	13	..	64	487	17	1,465	31·2	*5,272*	*21·4*
Paddington	2,966	2,223	16	..	75	290	34	328	12·2	*1,426*	*9·5*
Pancras, St.	6,861	3,549	29	..	104	767	225	2,187	35·2	*5,734*	*16·3*
Poplar	5,914	1,286	5	..	13	863	30	3,717	63·4	*9,306*	*31·4*
Saviour, St.	7,047	3,778	18	..	65	951	10	2,225	31·7	*6,981*	*19·4*
Shoreditch	4,295	744	2	..	16	595	132	2,806	68·4	*9,595*	*43·9*
Stepney	1,913	719	5	..	9	260	8	912	48·1	*3,391*	*34·2*
Strand	416	257	4	..	6	50	13	86	23·8	*374*	*15·4*
Wandsworth and Clapham.	10,396	5,853	44	..	185	1,152	484	2,678	30·4	*9,434*	*19·0*
Westminster	706	526	1	..	13	56	3	107	15·6	*791*	*19·9*
Whitechapel	3,129	2,477	7	..	34	275	30	306	10·7	*895*	*5·7*
Woolwich	3,570	2,774	22	..	157	410	20	187	5·8	*762*	*4·2*
	132,785	71,408	471	..	1,814	15,301	2,325	41,466	33·0	*159,127*	*23·9*

* This Union was constituted on 26th March, 1899. It previously formed part of Fulham.

PP. A, No. 1.

lgest of accination ficers' eturns, 1898.

	Returns, 1898.									Children remaining "unaccounted for" when the Returns for the several Years were received.	
	Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Number in respect of whom Certificates of conscientious objection have been received.	Died unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of births.	*Total number for the Years 1893–97.*	*Average percentage for the Years 1893–97.*
BEDFORD.											
Ampthill	329	106	..	..	114	30	2	77	24·0	*653*	*34·1*
Bedford	1,267	202	..	..	213	176	29	647	53·4	*4,367*	*66·1*
Biggleswade	710	193	1	..	13	83	4	416	59·2	*2,881*	*75·1*
Leighton Buzzard ..	444	92	..	..	263	56	3	30	7·4	*1,760*	*73·8*
Luton	1,451	33	..	..	84	251	..	1,083	74·6	*5,445*	*81·7*
	4,201	626	1	..	687	596	38	2,263	54·5	*15,106*	*70·6*
BERKS.											
Abingdon	441	383	2	..	7	29	5	15	4·5	*77*	*3·1*
Bradfield	403	332	1	..	14	21	11	24	8·7	*95*	*4·3*
Easthampstead	329	279	1	..	5	31	2	11	4·0	*144*	*8·1*
Faringdon..	363	280	3	..	6	33	16	25	11·3	*246*	*13·9*
Hungerford and Ramsbury.	426	370	..	..	10	34	1	11	2·8	*71*	*3·1*
Maidenhead	579	398	1	..	64	62	7	47	9·3	*430*	*14·7*
Newbury	536	442	..	..	11	46	18	19	6·9	*209*	*7·8*
Reading	1,852	419	3	..	27	299	22	1,082	59·6	*2,178*	*23·7*
Wallingford	344	286	5	..	10	26	7	10	4·9	*55*	*3·2*
Wantage	405	330	1	..	16	34	9	15	5·9	*167*	*7·4*
Windsor	932	699	6	..	19	86	22	100	13·1	*470*	*10·0*
Wokingham	419	309	..	..	4	35	..	71	16·9	*265*	*12·7*
	7,029	4,527	23	..	193	736	120	1,430	22·1	*4,407*	*12·2*
BUCKINGHAM.											
Amersham	556	189	1	1	124	43	..	198	35·6	*1,317*	*45·1*
Aylesbury..	581	482	..	..	26	38	22	13	6·0	*145*	*4·5*
Buckingham	265	180	2	..	25	21	1	36	14·0	*206*	*14·3*
Eton..	796	618	2	..	22	76	15	63	9·8	*326*	*8·1*
Newport Pagnell ..	715	447	2	..	161	70	5	30	4·9	*750*	*19·8*
Winslow	193	54	1	..	101	24	1	12	6·7	*585*	*59·8*
Wycombe	1,240	636	..	..	109	149	19	327	27·9	*2,867*	*44·4*
	4,346	2,606	8	1	568	421	63	679	17·1	*6,196*	*27·1*
CAMBRIDGE.											
Cambridge	885	524	5	..	39	91	7	219	25·5	*796*	*16·8*
Caxton and Arrington	222	198	1	..	6	9	..	8	3·6	*35*	*3·2*
Chesterton	796	626	2	..	13	60	13	83	11·9	*444*	*11·0*
Ely	484	368	2	..	18	49	11	36	9·7	*395*	*14·3*
Linton	256	201	..	..	..	26	9	20	11·3	*97*	*6·1*
Newmarket	874	673	2	..	12	92	72	23	10·9	*313*	*6·8*
North Witchford ..	480	413	..	..	25	37	..	5	1·0	*64*	*2·7*
Whittlesey	219	181	1	..	1	23	..	13	5·9	*21*	*2·2*
Wisbech	846	607	3	..	7	103	16	110	14·9	*356*	*8·4*
	5,062	3,791	16	..	121	490	128	516	12·7	*2,521*	*9·5*

	Returns, 1898. Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Number in respect of whom Certificates of conscientious objection have been received.	Died unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of births.	Children remaining "unaccounted for" when the Returns for the several Years were received. Total number for the Years 1893-97.	Average percentage for the Years 1893-97.
CHESTER.											
Birkenhead	4,754	4,003	14	..	11	552	47	127	3·7	*526*	*2·3*
Bucklow	1,936	1,638	16	..	15	201	27	39	3·4	*305*	*3·5*
Chester	1,443	1,133	3	..	4	185	29	89	8·2	*309*	*4·2*
Congleton	907	705	2	..	16	80	49	55	11·5	*369*	*7·3*
Macclesfield	1,552	1,292	9	..	23	174	15	39	3·5	*386*	*4·9*
Nantwich	2,227	1,655	3	..	70	266	45	188	10·5	*942*	*8·8*
Northwich	1,852	1,631	1	..	11	183	10	16	1·4	*172*	*1·7*
Runcorn	1,186	1,031	4	..	9	111	13	18	2·6	*614*	*9·2*
Stockport	4,182	2,908	15	..	161	710	54	334	9·3	*2,907*	*13·9*
Tarvin	408	351	..	..	2	41	..	14	3·4	*22*	*1·1*
Wirral	1,101	912	5	..	1	124	17	42	5·4	*395*	*7·3*
	21,548	17,259	72	..	323	2,627	306	961	5·9	*6,947*	*6·5*
CORNWALL.											
Austell, St.	919	684	7	..	15	112	12	89	11·0	*778*	*16·9*
Bodmin	481	374	2	..	6	40	12	47	12·3	*193*	*8·2*
Camelford	194	165	..	..	3	10	12	4	8·2	*106*	*10·9*
Columb Major, St. ..	369	268	..	..	1	34	22	44	17·9	*452*	*22·8*
Falmouth	566	77	..	..	23	71	8	387	69·8	*2,291*	*18·4*
Germans, St.	483	414	1	..	1	37	10	20	6·2	*104*	*4·7*
Helston	538	353	..	..	1	78	13	93	19·7	*397*	*13·6*
Launceston	331	271	..	..	19	27	3	11	4·2	*109*	*5·9*
Liskeard	603	421	1	..	13	57	8	103	18·4	*489*	*15·0*
Penzance	1,262	817	3	..	3	208	18	213	18·3	*1,131*	*17·1*
Redruth	1,208	485	..	..	5	235	32	451	40·0	*2,536*	*37·0*
Stratton	177	120	..	..	..	20	2	35	20·9	*102*	*10·9*
Truro	761	508	..	..	20	93	20	120	18·4	*1,787*	*44·1*
	7,892	4,957	14	..	110	1,022	172	1,617	22·7	*10,475*	*25·2*
CUMBERLAND.											
Alston-with-Garrigill ..	61	41	1	..	11	7	..	1	1·6	*25*	*7·0*
Bootle	440	339	2	..	10	37	..	52	11·8	*223*	*9·7*
Brampton	217	152	..	..	1	19	17	28	20·7	*169*	*14·2*
Carlisle	1,714	1,386	3	..	7	207	67	44	6·5	*559*	*6·5*
Cockermouth	2,074	670	..	..	195	235	111	863	47·0	*4,934*	*45·2*
Longtown	183	157	2	..	..	10	3	11	7·7	*56*	*6·2*
Penrith	533	431	..	..	42	48	7	5	2·3	*126*	*4·2*
Whitehaven	1,730	1,433	6	..	45	170	19	57	4·4	*499*	*5·6*
Wigton	597	477	3	..	19	67	12	19	5·2	*133*	*4·0*
	7,549	5,086	17	..	330	800	236	1,080	17·4	*6,724*	*17·0*
DERBY.											
Ashbourne	579	398	2	..	9	50	10	110	20·7	*292*	*10·5*
Bakewell	899	639	5	..	34	85	14	122	15·1	*603*	*14·0*
Belper	2,178	1,185	5	..	182	259	48	499	25·1	*1,971*	*18·2*
Chapel-en-le-Frith ..	687	524	..	..	16	66	23	58	11·8	*368*	*11·1*
Chesterfield	4,644	2,198	12	..	9	663	125	1,637	37·9	*6,523*	*28·5*
Derby	2,869	436	1	..	33	436	..	1,963	68·4	*10,814*	*73·5*
Glossop	679	268	2	..	19	97	26	267	43·2	*1,819*	*51·2*
Hayfield	357	262	..	..	..	38	4	53	16·0	*228*	*13·3*
Shardlow	1,899	757	3	..	152	229	37	721	39·9	*3,403*	*37·7*
	14,791	6,667	30	..	454	1,923	287	5,430	38·7	*26,021*	*35·6*

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	Returns, 1898.									Children remaining "unaccounted for" when the Returns for the several Years were received.	
	Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Number in respect of whom Certificates of conscientious objection have been received.	Died unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of births.	*Total number for the Years 1893-97.*	*Average percentage for the Years 1893-97.*
DEVON.											
Axminster	369	315	1	..	5	29	5	14	5·1	*122*	*6·0*
Barnstaple	1,016	747	1	..	36	102	55	75	12·8	*378*	*7·1*
Bideford	565	468	..	..	12	54	22	9	5·5	*134*	*4·5*
Crediton	383	356	1	..	1	21	..	4	1·0	*76*	*3·4*
Devonport	1,668	820	14	..	6	198	66	564	37·8	*1,199*	*15·4*
East Stonehouse ..	463	271	2	..	..	64	5	121	27·2	*521*	*21·4*
Exeter	868	630	1	..	15	93	66	63	14·9	*642*	*13·6*
Holsworthy	245	209	1	..	5	20	5	5	4·1	*36*	*2·9*
Honiton	434	385	2	..	9	30	1	7	1·8	*71*	*2·9*
Kingsbridge	418	372	..	..	7	21	2	16	4·3	*72*	*3·3*
Newton Abbot	1,673	1,398	6	..	30	152	35	52	5·2	*276*	*3·1*
Okehampton	393	318	..	..	12	29	14	20	8·7	*135*	*6·5*
Plymouth	2,946	1,587	7	..	17	362	109	864	33·0	*2,351*	*18·0*
Plympton St. Mary ..	650	442	1	..	5	76	4	122	19·4	*389*	*11·3*
South Molton	344	308	..	..	4	22	3	7	2·9	*66*	*3·5*
Tavistock	591	505	2	..	25	45	1	13	2·4	*96*	*3·0*
Thomas, St.	1,326	974	2	..	9	111	84	46	10·6	*557*	*8·4*
Tiverton	699	554	1	..	15	62	16	51	9·6	*213*	*5·7*
Torrington	301	259	1	..	4	20	5	12	5·6	*70*	*4·2*
Totnes	971	847	7	..	9	82	8	18	2·7	*89*	*1·7*
	16,223	11,765	50	..	226	1,593	506	2,083	16·0	*7,493*	*9·0*
DORSET.											
Beaminster	238	214	2	..	2	10	3	7	4·2	*61*	*4·7*
Blandford	280	201	..	..	13	15	1	50	18·2	*229*	*14·7*
Bridport	306	268	1	..	3	23	2	9	3·6	*28*	*1·7*
Cerne	122	102	..	..	8	9	2	1	2·5	*21*	*2·8*
Dorchester	449	354	..	..	7	26	6	56	13·8	*188*	*8·0*
Poole	889	562	..	..	76	93	38	120	17·8	*1,049*	*23·5*
Shaftesbury	324	266	1	..	15	15	6	21	8·3	*152*	*10·3*
Sherborne	247	208	1	..	3	18	1	16	6·9	*128*	*8·8*
Sturminster	225	200	..	..	2	13	4	6	4·4	*36*	*3·1*
Wareham and Purbeck	402	349	..	..	5	27	9	12	5·2	*74*	*3·6*
Weymouth	937	338	..	..	536	63	..	..	0·0	*1,585*	*35·8*
Wimborne and Cranborne.	435	378	..	..	6	22	8	21	6·7	*319*	*13·5*
	4,854	3,440	5	..	676	334	80	319	8·2	*3,870*	*15·5*
DURHAM.											
Auckland	3,226	1,820	16	..	209	508	77	596	20·9	*3,523*	*21·6*
Chester-le-Street ..	2,273	1,664	12	..	16	328	70	183	11·1	*828*	*7·7*
Darlington	1,488	541	3	..	19	207	3	715	48·3	*3,860*	*51·8*
Durham	2,458	1,683	15	..	14	343	65	338	16·4	*1,130*	*9·0*
Easington	1,809	1,509	2	..	12	212	21	53	4·1	*345*	*3·4*
Gateshead	5,785	2,431	10	..	636	852	95	1,761	32·1	*9,655*	*36·2*
Hartlepool	2,738	2,110	24	..	51	329	48	176	8·2	*1,091*	*8·4*
Houghton-le-Spring ..	1,562	1,171	33	..	8	251	24	75	6·3	*279*	*3·6*
Lanchester	3,012	1,834	17	..	57	489	102	513	20·4	*1,966*	*15·2*
Sedgefield	750	625	2	..	5	85	2	31	4·4	*116*	*3·1*
South Shields	5,730	3,653	25	..	39	754	240	1,020	22·0	*4,849*	*18·1*
Stockton	1,978	1,562	10	..	21	249	21	115	6·9	*727*	*7·1*
Sunderland	6,352	4,355	27	..	26	974	161	809	15·3	*3,963*	*13·1*
Teesdale	602	259	1	..	24	75	30	113	23·8	*837*	*27·7*
Weardale	478	392	..	..	15	55	5	11	3·3	*134*	*5·7*
	40,241	25,708	197	..	1,152	5,711	964	6,509	18·6	*33,303*	*17·2*

Digest of Vaccinati Officers' Returns, 1

—	Returns, 1898. Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Number in respect of whom Certificates of conscientious objection have been received.	Died unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of births.	Children remaining "unaccounted for" when the Returns for the several Years were received. *Total number for the Years 1893-97.*	*Average percentage for the Years 1893-97.*
ESSEX.											
Billericay	459	359	1	..	13	37	4	45	10·7	*223*	*9·5*
Braintree	578	404	3	..	10	44	49	68	20·2	*237*	*7·2*
Chelmsford	845	701	1	..	27	65	9	42	6·0	*314*	*7·2*
Colchester	969	463	5	..	17	96	14	374	40·0	*970*	*19·4*
Dunmow	371	307	2	..	13	22	2	25	7·3	*106*	*5·3*
Epping	706	567	4	..	13	58	4	60	9·1	*248*	*7·1*
Halstead	388	292	..	..	31	37	11	17	7·2	*113*	*5·5*
Lexden and Winstree ..	571	471	1	..	30	37	2	30	5·6	*141*	*4·8*
Maldon	597	458	2	..	32	47	3	55	9·7	*156*	*5·0*
Ongar	236	181	1	..	..	14	1	39	16·9	*121*	*8·9*
Orsett	951	350	..	..	354	107	19	121	14·7	*1,601*	*34·1*
Rochford	1,233	523	3	..	101	145	19	442	37·4	*1,423*	*27·0*
Romford	2,292	1,398	8	..	34	259	52	541	25·9	*2,251*	*22·4*
Saffron Walden ..	375	308	..	..	4	38	1	24	6·7	*140*	*6·5*
Tendring	1,154	790	5	..	50	97	40	172	18·4	*445*	*7·6*
West Ham	16,802	7,554	41	..	178	1,816	642	6,571	42·9	*18,582*	*24·7*
	28,527	15,126	77	..	907	2,919	872	8,626	33·3	*27,071*	*20·3*
GLOUCESTER.											
Barton Regis	369	261	..	..	1	33	45	29	20·1	*6,124*	*20·6*
Bristol	9,120	3,698	26	..	269	1,059	278	3,790	44·6	*4,249*	*27·8*
Cheltenham	1,291	336	6	..	116	180	4	649	50·6	*2,715*	*43·7*
Chipping Sodbury ..	462	281	2	..	8	43	17	111	27·7	*459*	*21·0*
Cirencester	482	379	2	..	33	38	8	22	6·2	*322*	*12·8*
Dursley	279	164	1	..	31	27	6	50	20·1	*665*	*43·7*
Gloucester	1,603	407	3	..	474	243	35	441	29·7	*4,202*	*54·2*
Newent	214	177	..	..	10	10	5	12	7·9	*207*	*15·5*
Northleach	202	176	..	..	4	10	3	9	5·9	*72*	*6·8*
Stow-on-the-Wold ..	205	153	3	..	18	11	5	15	9·8	*152*	*13·4*
Stroud	907	355	3	..	285	80	14	170	20·3	*2,603*	*52·0*
Tetbury	169	89	..	..	35	17	1	27	16·6	*276*	*32·5*
Tewkesbury	360	85	..	..	118	41	2	114	32·2	*1,020*	*56·2*
Thornbury	428	347	3	..	30	18	7	23	7·0	*185*	*8·2*
Westbury-on-Severn ..	680	224	2	..	303	58	24	69	13·7	*2,606*	*70·9*
Wheatenhurst	150	86	..	..	13	12	33	6	26·0	*371*	*48·1*
Winchcomb	246	173	..	..	..	21	..	52	21·1	*149*	*12·3*
	17,167	7,391	51	..	1,748	1,901	487	5,589	35·4	*26,377*	*31·3*
HEREFORD.											
Bromyard	256	178	..	..	6	25	7	40	18·4	*173*	*11·6*
Dore	211	155	..	..	2	14	4	36	19·0	*123*	*12·6*
Hereford	853	658	2	..	16	99	16	62	9·1	*345*	*7·6*
Kington	236	176	1	..	1	15	2	41	18·2	*133*	*9·3*
Ledbury	362	291	2	..	2	25	10	32	11·6	*106*	*6·0*
Leominster	315	251	..	..	6	29	11	18	9·2	*111*	*6·4*
Ross	406	303	3	..	31	41	8	20	6.9	*230*	*10·1*
Woobley	170	123	1	..	1	12	4	29	19·4	*86*	*8·9*
	2,800	2,135	9	..	65	260	62	278	12·1	*1,307*	*8·6*

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HERTS.											
Albans, St.	752	59	2	..	191	58	..	442	58·8	*2,297*	*62·3*
Barnet	1,363	880	6	..	43	133	..	292	21·4	*1,257*	*19·7*
Berkhampstead	400	270	..	..	38	41	13	38	12·7	*244*	*11·5*
Bishop Stortford	477	380	1	..	9	44	6	37	9·0	*155*	*5·8*
Buntingford	118	99	1	..	1	7	..	10	8·5	*35*	*5·5*
Hatfield	185	162	1	..	4	10	3	5	4·3	*61*	*6·1*
Hemel Hempstead	414	199	1	..	23	42	23	126	36·0	*513*	*25·5*
Hertford	388	332	..	..	10	28	4	14	4·6	*134*	*6·3*
Hitchin	742	615	4	..	41	55	3	24	3·6	*151*	*4·2*
Royston	373	304	1	..	18	31	3	16	5·1	*106*	*5·0*
Ware	511	394	1	..	11	54	1	50	10·0	*186*	*6·9*
Watford	1,259	683	7	..	23	123	54	369	33·6	*1,991*	*33·9*
Welwyn	57	39	1	..	3	9	..	5	8·8	*15*	*5·6*
	7,039	4,425	26	..	415	635	110	1,428	21·8	*7,145*	*20·3*
HUNTINGDON.											
Huntingdon	476	404	1	..	13	33	6	19	5·3	*99*	*3·9*
Ives, St.	358	307	4	..	10	28	1	8	2·5	*60*	*2·6*
Neots, St.	364	280	2	..	13	32	3	34	10·2	*230*	*12·7*
	1,198	991	7	..	36	93	10	61	5·9	*379*	*6·0*
KENT (Extra Metropolitan).											
Ashford, East	295	239	2	..	22	17	2	13	5·1	*73*	*4·2*
Ashford, West	458	349	3	..	18	40	16	32	10·5	*279*	*11·2*
Blean	538	422	..	..	22	51	7	36	8·0	*180*	*6·6*
Bridge	281	219	..	..	20	20	11	11	7·8	*120*	*8·0*
Bromley	1,916	1,315	12	..	26	197	48	318	19·1	*1,927*	*20·7*
Canterbury	472	296	..	..	3	69	..	104	22·0	*258*	*10·7*
Cranbrook	290	234	..	..	13	9	7	27	11·7	*147*	*9·0*
Dartford	2,482	1,917	12	..	62	302	54	136	7·6	*962*	*8·6*
Dover	1,253	695	5	..	3	151	16	383	31·8	*1,306*	*23·4*
Eastry	681	566	3	..	8	67	5	32	5·4	*136*	*3·7*
Elham	1,186	916	13	..	6	116	18	117	11·4	*514*	*9·3*
Faversham	776	687	5	..	10	57	3	14	2·2	*86*	*2·2*
Gravesend and Milton	676	321	4	..	8	80	4	259	38·9	*594*	*18·4*
Hollingbourn	307	243	..	..	1	28	12	23	11·4	*127*	*7·3*
Hoo	101	87	1	..	.	8	3	2	5·0	*16*	*2·6*
Maidstone	1,105	655	3	..	19	108	43	267	28·1	*1,883*	*30·1*
Malling	781	656	3	..	11	70	8	33	5·2	*187*	*4·7*
Medway	2,473	1,969	5	..	17	264	57	161	8·8	*985*	*8·4*
Milton	856	658	3	..	2	101	6	86	10·7	*576*	*13·8*
Romney Marsh	167	144	2	..	4	5	1	11	7·2	*22*	*2·5*
Sevenoaks	681	528	..	..	8	36	13	96	16·0	*371*	*9·8*
Sheppey	513	330	1	..	14	70	69	29	19·1	*221*	*9·0*
Strood	1,176	940	6	..	31	125	18	56	6·3	*366*	*5·9*
Tenterden	222	175	2	..	5	17	6	17	10·4	*83*	*6·5*
Thanet, Isle of	1,532	1,041	7	..	141	188	17	138	10·1	*427*	*6·1*
Tonbridge	1,472	703	6	..	354	152	31	226	17·5	*2,886*	*38·0*
	22,690	16,305	98	..	838	2,348	475	2,626	13·7	*14,732*	*13·1*

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LANCASTER.											
ton-under-Lyne ..	4,978	1,866	8	..	1,072	871	72	1,089	23·3	*13,499*	*54·6*
row-in-Furness ..	1,528	1,284	2	..	23	174	17	28	2·9	*349*	*4·4*
ton-upon-Irwell ..	2,863	1,678	8	..	24	381	117	655	27·0	*3,236*	*23·5*
kburn	6,409	4,317	16	..	369	1,000	109	598	11·0	*3,892*	*12·2*
on	7,596	5,924	25	..	34	1,022	57	534	7·8	*2,856*	*7·4*
nley	5,810	1,170	18	..	1,676	906	58	1,982	35·1	*16,250*	*55·3*
y	3,664	1,335	1	..	1,305	524	24	475	13·6	*9,997*	*53·7*
rley	1,760	1,228	6	..	11	223	44	248	16·6	*1,059*	*11·3*
rlton	9,803	5,569	49	..	45	1,521	165	2,454	26·7	*7,772*	*16·2*
heroe	555	422	1	..	21	67	10	34	7·9	*404*	*13·4*
le, The	2,422	1,316	16	..	49	350	66	625	28·5	*1,580*	*16·4*
stang	255	223	..	..	10	18	2	2	1·6	*63*	*4·4*
lingden	2,956	1,516	3	..	782	379	59	217	9·3	*3,338*	*22·9*
caster	1,756	1,315	5	..	27	247	43	119	9·2	*514*	*6·5*
h	2,880	2,124	4	..	10	417	20	305	11·3	*1,676*	*11·7*
rpool	5,059	4,112	22	..	5	653	19	248	5·3	*1,055*	*4·1*
esdale	186	125	..	..	..	17	17	27	23·7	*120*	*13·3*
chester	4,846	3,389	12	..	17	719	118	591	14·6	*994*	*3·9*
nam	5,883	715	3	..	1,394	1,016	11	2,744	46·8	*20,954*	*70·6*
skirk	2,640	2,165	18	..	36	263	25	133	6·0	*820*	*5·9*
cot	5,463	4,449	22	..	30	628	36	298	6·1	*1,963*	*7·2*
ton	4,542	2,725	4	..	48	769	96	900	21·9	*4,353*	*18·6*
twich	5,734	3,846	26	..	25	708	122	1,007	19·7	*4,749*	*18·3*
hdale	2,949	625	3	..	1,465	350	11	495	17·2	*8,271*	*56·4*
ord	7,722	4,659	30	..	53	1,202	191	1,587	23·0	*7,149*	*19·0*
morden	965	365	2	..	400	112	16	70	8·9	*2,897*	*62·4*
teth Park	4,136	2,800	22	..	18	520	307	469	18·8	*2,528*	*12·0*
erston	1,129	984	2	..	10	95	13	25	3·4	*230*	*4·1*
rington	3,497	2,569	15	..	21	495	61	336	11·4	*1,132*	*67·8*
t Derby	16,606	12,979	90	..	38	1,921	223	1,355	9·5	*5,721*	*7·2*
an	6,856	5,114	13	..	150	963	109	507	9·0	*5,279*	*14·9*
	133,448	82,908	446	..	9,168	18,531	2,238	20,157	16·8	*134,700*	*20·4*
LEICESTER.											
by-de-la-Zouch ..	1,456	330	1	..	440	182	16	487	34·5	*4,254*	*61·5*
row-on-Soar ..	738	56	..	..	469	94	..	119	16·1	*2,735*	*75·8*
sdon	148	102	1	..	19	12	..	14	9·5	*113*	*17·1*
y	744	57	..	..	145	74	5	463	62·9	*2,818*	*74·6*
ckley	797	95	..	..	382	124	..	196	24·6	*2,660*	*68·4*
ester	6,164	87	..	..	1,075	1,069	..	3,933	63·8	*24,491*	*80·8*
ghborough	952	107	..	..	558	138	10	139	15·7	*3,266*	*68·1*
erworth	275	74	..	..	42	26	1	132	48·4	*545*	*38·9*
ket Bosworth ..	532	130	1	..	229	43	5	124	24·2	*1,177*	*43·6*
ket Harborough ..	472	28	..	..	..	38	..	406	86·0	*671*	*31·2*
ton Mowbray ..	600	162	1	..	302	74	2	59	10·2	*1,891*	*61·8*
	12,878	1,228	4	..	3,661	1,874	39	6,072	47·5	*44,621*	*72·0*
LINCOLN.											
on	1,046	524	3	..	132	120	31	236	25·5	*1,562*	*29·3*
rne	499	306	..	..	42	49	4	98	20·4	*412*	*16·5*
tor	382	265	1	..	52	39	8	17	6·5	*182*	*8·6*
sborough	1,010	232	..	..	481	156	9	132	14·0	*2,791*	*53·4*
ford Brigg	1,433	518	3	..	615	194	6	97	7·2	*1,570*	*23·8*
tham	925	559	3	..	84	118	29	132	17·4	*349*	*7·6*

A, No. 1.
...st of
...ination
...ors'
...urns, 1898.

	Returns, 1898.									Children remaining "unaccounted for" when the Returns for the several Years were received.	
—	Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Number in respect of whom Certificates of conscientious objection have been received.	Died unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of births.	*Total number for the Years 1893–97.*	*Average percentage for the Years 1893–97.*
LINCOLN—*cont.*											
Grimsby	2,364	1,189	15	..	130	441	34	555	24·9	*2,429*	*20·9*
Holbeach	477	244	1	..	150	56	4	22	5·5	*1,025*	*45·6*
Horncastle	463	328	2	..	10	31	10	82	19·9	*509*	*21·0*
Lincoln	1,787	1,225	7	..	130	260	35	130	9·2	*1,160*	*12·1*
Louth	725	481	8	..	42	73	22	99	16·7	*499*	*13·7*
Sleaford	586	332	2	..	118	77	15	42	9·7	*674*	*21·4*
Spalding	534	194	..	..	199	46	4	91	17·8	*1,509*	*53·5*
Spilsby	574	487	2	..	7	59	8	11	3·3	*153*	*5·4*
Stamford	402	327	2	..	12	34	..	27	6·7	*123*	*6·0*
	13,207	7,211	49	..	2,204	1,753	219	1,771	15·1	*14,947*	*22·4*
MIDDLESEX (Extra Metropolitan).											
Brentford	4,378	2,867	42	..	26	507	71	865	21·4	*1,842*	*8·9*
Edmonton..	8,498	4,360	22	..	146	870	231	2,869	36·5	*9,288*	*23·1*
Hendon	1,203	876	5	..	36	135	27	124	12·6	*2,175*	*17·5*
Staines	874	655	3	..	9	81	16	110	14·4	*609*	*14·5*
Uxbridge	947	776	4	..	18	79	12	58	7·4	*271*	*6·3*
Willesden	3,125	1,728	19	..	41	288	43	1,006	33·6	*1,399*	*24·9*
	19,025	11,262	95	..	276	1,960	400	5,032	28·6	*15,584*	*18·4*
MONMOUTH.											
Abergavenny	797	572	1	..	4	93	2	125	15·9	*328*	*8·6*
Bedwellty	3,003	1,748	1	..	30	333	148	743	29·7	*3,553*	*25·4*
Chepstow	554	390	3	..	75	42	7	37	7·9	*486*	*17·4*
Monmouth	833	373	2	..	196	70	2	190	23·0	*942*	*22·0*
Newport	3,648	2,623	26	..	62	414	134	389	14·3	*1,356*	*7·3*
Pontypool	1,460	1,182	..	..	9	133	33	109	9·7	*1,259*	*17·0*
	10,301	6,888	33	..	376	1,065	326	1,593	18·6	*7,924*	*15·6*
NORFOLK.											
Aylsham	456	361	1	..	21	55	3	15	3·9	*130*	*5·4*
Blofield	275	219	..	..	6	28	7	15	8·0	*187*	*13·0*
Depwade	493	382	1	..	38	40	7	25	6·5	*258*	*8·8*
Docking	428	372	..	..	7	27	7	15	5·1	*240*	*10·9*
Downham	438	352	2	..	7	45	3	29	7·3	*135*	*5·4*
Erpingham	597	428	..	..	50	59	18	42	10·1	*348*	*12·3*
Faith, St.	343	210	..	..	78	30	1	24	7·3	*526*	*30·9*
Flegg, East and West ..	278	216	6	..	7	35	5	9	5·0	*99*	*6·4*
Forehoe	283	149	..	..	20	17	1	96	34·3	*248*	*16·3*
Freebridge Lynn ..	321	267	2	..	4	34	1	13	4·4	*94*	*5·7*
Guiltcross..	238	184	1	..	16	19	..	18	7·6	*78*	*6·1*
Henstead	246	186	..	..	14	21	4	21	10·2	*209*	*15·3*
King's Lynn	594	30	..	..	15	124	5	420	71·5	*2,243*	*78·8*
Loddon and Clavering	317	255	..	..	4	31	3	24	8·5	*129*	*7·5*
Mitford and Launditch	608	451	4	..	28	58	10	57	11·0	*309*	*9·3*
Norwich	3,344	407	1	..	1,756	599	3	578	17·4	*10,391*	*63·0*
Smallburgh	466	354	..	..	15	60	1	36	7·9	*307*	*13·4*
Swaffham..	278	213	..	..	12	23	6	24	10·8	*253*	*15·7*
Thetford	397	304	1	..	36	43	4	9	3·3	*93*	*4·1*
Walsingham	557	432	1	..	39	51	14	20	6·1	*218*	*8·3*
Wayland	211	158	..	..	15	29	3	6	4·3	*71*	*5·3*
Yarmouth, Great ..	1,397	896	1	..	124	227	14	133	10·5	*1,123*	*15·8*
	12,565	6,828	21	..	2,312	1,655	120	1,629	13·9	*17,689*	*27·2*

APP. A, No. 1.

Digest of Vaccination Officers' Returns, 1898.

	Returns, 1898.									Children remaining "unaccounted for" when the Returns for the several Years were received.	
	Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Number in respect of whom Certificates of conscientious objection have been received.	Died unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of births.	*Total number for the Years 1893–97.*	*Average percentage for the Years 1893–97.*
ORTHAMPTON.											
xley	304	56	1	..	33	21	1	192	63·5	*707*	*47·7*
worth	292	52	..	..	77	21	..	142	48·6	*674*	*44·2*
ntry	417	175	..	..	81	37	7	117	29·7	*855*	*36·3*
ingstone	326	97	1	..	158	33	4	33	11·3	*656*	*42·7*
ring	1,478	35	..	..	480	250	2	711	48·2	*5,731*	*84·2*
ampton	2,513	106	..	..	1,220	360	6	821	32·9	*9,479*	*74·2*
le	222	183	1	..	5	15	3	15	8·1	*129*	*9·0*
borough	1,432	1,021	1	..	12	159	11	228	16·7	*501*	*7·6*
rspury	321	139	..	..	122	28	7	25	10·0	*483*	*29·2*
pston..	405	78	2	..	182	35	2	106	26·7	*1,421*	*72·0*
ester..	299	108	..	..	128	32	5	26	10·4	*653*	*43·9*
ngborough.. ..	1,732	35	..	..	744	206	1	746	43·1	*6,458*	*82·2*
	9,741	2,085	6	..	3,242	1,197	49	3,162	33·0	*27,747*	*58·4*
THUMBERLAND.											
ick	627	451	1	..	18	69	17	71	14·0	*338*	*10·2*
rd	123	105	..	..	1	15	2	..	1·6	*23*	*3·6*
gham	143	102	..	..	3	18	3	17	14·0	*64*	*9·6*
ick-upon-Tweed	517	446	2	..	..	48	12	9	4·1	*89*	*3·3*
Ward	834	465	..	..	19	88	..	262	31·4	*424*	*11·5*
dale	199	181	..	..	1	14	..	3	1·5	*51*	*4·9*
whistle	225	103	1	..	69	14	2	36	16·9	*498*	*45·3*
am	861	559	2	..	17	101	4	178	21·1	*495*	*10·6*
eth	1,776	648	1	..	10	336	21	760	44·0	*2,879*	*31·7*
astle-on-Tyne ..	7,580	5,040	37	..	99	1,013	59	1,332	18·4	*4,035*	*11·5*
bury	146	128	1	..	..	11	3	3	4·1	*12*	*1·7*
mouth	5,302	3,285	19	..	170	767	189	872	20·0	*4,379*	*17·4*
	18,333	11,513	64	..	407	2,494	312	3,543	21·0	*13,287*	*15·1*
OTTINGHAM.											
rd	6,090	2,162	13	..	1,017	838	57	2,003	33·8	*8,895*	*29·2*
am	317	259	1	..	25	19	4	9	4·1	*180*	*10·3*
Retford	681	545	5	..	32	53	8	38	6·8	*227*	*6·7*
field	2,826	1,601	1	..	52	382	47	743	28·0	*4,440*	*34·5*
rk	778	463	3	..	62	72	11	167	22·9	*292*	*7·4*
ngham	5,425	1,753	11	..	1,088	924	173	1,476	30·4	*9,910*	*37·4*
well	507	344	4	..	31	47	19	62	16·0	*303*	*12·5*
sop	1,254	913	5	..	17	173	25	121	11·6	*397*	*6·7*
	17,878	8,040	43	..	2,324	2,508	344	4,619	27·8	*24,644*	*28·2*
OXFORD.											
ury	697	231	..	..	323	60	9	74	11·9	*2,333*	*61·2*
er	318	207	..	..	10	31	5	65	22·0	*193*	*11·1*
ing Norton ..	430	215	..	..	55	33	15	112	29·5	*768*	*34·0*
ngton	913	802	6	..	16	67	2	20	2·4	*133*	*2·8*
y	568	396	1	..	39	27	5	100	18·5	*376*	*12·1*
d	578	453	3	..	23	57	6	36	7·3	*169*	*5·6*
e	322	261	..	..	22	26	1	12	4·0	*141*	*8·4*
y	481	392	1	..	18	38	11	21	6·7	*142*	*5·2*
stock	322	270	..	..	16	15	3	18	6·5	*157*	*9·1*
	4,629	3,227	11	..	522	354	57	458	11·1	*4,412*	*17·8*

.PP. A, No. 1.

)igest of 'accination)fficers' leturns, 1898.

	Returns, 1898.									Children remainin "unaccoun for" when Returns f the severa Years we received.	
	Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Number in respect of whom Certificates of conscientious objection have been received.	Died unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of births.	*Total number for the Years 1893-1897.*	*Average percentage*
RUTLAND.											
Oakham	244	203	..	..	9	24	1	7	3·3	*69*	
Uppingham	216	184	2	..	6	15	1	8	4·2	*69*	
	460	387	2	..	15	39	2	15	3·7	*138*	
SALOP.											
Atcham	1,193	954	1	..	6	126	32	74	8·9	*763*	
Bridgnorth	387	313	..	..	6	42	3	23	6·7	*138*	
Church Stretton	127	110	1	..	2	12	..	2	1·6	*14*	
Cleobury Mortimer	224	195	..	..	2	17	2	8	4·5	*57*	
Clun	224	165	..	..	2	17	..	40	17·9	*367*	
Drayton	356	306	1	..	3	36	6	4	2·8	*31*	
Ellesmere	448	401	1	..	..	39	1	6	1·6	*54*	
Ludlow	489	392	..	..	14	49	7	27	7·0	*169*	
Madeley	671	552	..	..	3	64	13	39	7·7	*170*	
Newport	373	296	..	..	2	41	5	29	9·1	*103*	
Oswestry	760	655	3	..	4	58	15	25	5·3	*153*	
Shifnal	316	263	..	..	..	26	7	20	8·5	*184*	
Wellington	742	404	..	..	42	87	29	180	28·2	*1,427*	
Wem	290	237	..	..	10	31	6	6	4·1	*22*	
Whitchurch	305	234	..	..	..	30	10	31	13·4	*80*	
	6,905	5,477	7	..	96	675	136	514	9·4	*3,732*	
SOMERSET.											
Axbridge	1,048	386	2	..	291	127	31	211	23·1	*2,472*	
Bath	1,817	1,008	14	..	64	207	195	329	28·8	*1,873*	
Bridgwater	970	568	..	..	50	96	47	209	26·4	*1,282*	
Chard	646	544	..	..	8	63	16	15	4·8	*186*	
Clutton	796	527	1	..	33	65	18	152	21·4	*637*	
Dulverton	110	96	1	..	2	10	1	..	0·9	*14*	
Frome	528	318	1	..	44	44	11	110	22·9	*370*	
Keynsham	1,088	409	..	..	24	94	34	527	51·6	*2,075*	
Langport	346	280	..	..	8	26	10	22	9·2	*223*	
Long Ashton	594	380	5	..	8	44	20	137	26·4	*3,700*	
Shepton Mallet	401	263	1	..	74	28	7	28	8·7	*340*	
Taunton	975	783	4	..	24	86	29	49	8·0	*313*	
Wellington	455	343	2	..	46	34	6	24	6·6	*325*	
Wells	599	372	5	..	11	61	13	137	25·0	*419*	
Williton	376	319	..	..	22	22	4	9	3·5	*92*	
Wincanton	367	269	1	1	28	22	6	40	12·5	*203*	
Yeovil	704	522	..	..	57	60	19	46	9·2	*494*	
	11,820	7,387	37	1	794	1,089	467	2,045	21·3	*15,018*	
SOUTHAMPTON.											
Alresford	174	158	..	..	4	10	1	1	1·1	*19*	
Alton	356	307	2	..	3	24	2	18	5·6	*123*	
Alverstoke	833	687	8	..	5	95	5	33	4·6	*89*	
Andover	388	282	1	..	40	24	23	18	10·6	*253*	
Basingstoke	524	351	5	..	29	45	18	76	17·9	*1,096*	
Catherington	69	59	..	..	3	3	1	3	5·8	*40*	
Christchurch	1,312	521	5	..	29	115	..	642	48·9	*2,063*	
Droxford	273	250	..	..	2	15	1	5	2·2	*45*	
Fareham	475	414	2	..	5	24	7	23	6·3	*84*	
Fordingbridge	152	123	1	..	15	5	..	8	5·3	*46*	

	Returns, 1898.									Children remaining "unaccounted for" when the Returns for the several Years were received.	
	Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Number in respect of whom Certificates of conscientious objection have been received.	Died unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of births.	*Total number for the Years 1893–97.*	*Average percentage for the Years 1893–97.*
SOUTHAMPTON—*cont.*											
Hartley Wintney ..	731	572	1	..	15	64	6	73	10·8	*427*	*12·3*
Havant	272	229	..	..	1	17	11	14	9·2	*69*	*5·4*
Hursley	95	84	..	..	..	4	6	1	7·4	*21*	*4·6*
Kingsclere	220	190	..	..	4	21	1	4	2·3	*31*	*2·6*
Lymington	300	201	1	..	4	38	2	54	18·7	*170*	*10·2*
New Forest	373	297	..	..	1	33	3	39	11·3	*161*	*8·8*
Petersfield	309	232	2	..	16	23	11	25	11·7	*122*	*8·6*
Portsmouth	4,973	4,243	37	..	61	518	32	82	2·3	*654*	*2·7*
Ringwood	167	136	..	..	2	19	4	6	6·0	*26*	*3·3*
Romsey	269	207	..	..	9	20	4	29	13·3	*64*	*4·8*
Southampton	1,847	1,445	19	..	31	207	28	117	7·9	*585*	*6·4*
South Stoneham ..	2,123	1,423	10	..	33	226	62	369	20·3	*1,203*	*13·3*
Stockbridge	143	115	..	..	6	11	1	10	7·7	*50*	*6·0*
Whitchurch	186	138	..	..	6	23	3	16	10·2	*72*	*7·6*
Wight, Isle of	1,787	1,106	2	..	158	141	36	344	21·3	*1,249*	*13·3*
Winchester, New ..	774	617	1	..	39	65	17	35	6·7	*252*	*6·5*
	19,125	14,387	97	..	521	1,790	285	2,045	12·2	*8,944*	*9·5*
STAFFORD.											
Burton-upon-Trent ..	2,801	1,041	..	..	20	359	1	1,380	49·3	*5 862*	*41·6*
Cannock	1,565	1,349	5	..	38	164	6	103	7·0	*1,109*	*14·5*
Cheadle	742	614	..	..	7	79	13	29	5·7	*389*	*10·1*
Leek	1,301	958	1	..	161	120	39	22	4·7	*541*	*8·5*
Lichfield	1,282	1,116	6	..	9	103	16	32	3·7	*234*	*3·6*
Newcastle-under-Lyme	1,342	1,131	2	..	7	151	11	40	3·8	*92*	*1·3*
Seisdon	509	388	2	..	16	53	13	37	9·8	*340*	*14·6*
Stafford	818	646	5	..	44	76	14	33	5·7	*336*	*7·8*
Stoke-upon-Trent ..	5,438	3,135	10	..	19	906	95	1,273	25·2	*2,518*	*10·0*
Stone	514	308	1	..	4	47	10	144	30·0	*246*	*6·1*
Tamworth	739	411	..	..	22	77	20	209	31·0	*759*	*21·4*
Uttoxeter	415	304	3	..	7	44	13	44	13·7	*225*	*10·8*
Walsall	4,137	2,284	43	..	58	662	80	1,010	26·3	*6,675*	*34·3*
West Bromwich ..	5,475	2,179	15	..	482	801	153	1,845	36·5	*11,345*	*44·7*
Wolstanton and Burslem	3,569	2,579	8	..	11	521	16	434	12·6	*1,304*	*7·7*
Wolverhampton ..	5,453	2,068	20	..	228	869	78	2,190	41·6	*9,707*	*37·4*
	36,200	20,511	121	..	1,133	5,032	578	8,825	26·0	*41,682*	*23·9*
SUFFOLK.											
Blything	606	544	3	..	12	43	2	2	0·7	*120*	*3·4*
Bosmere and Claydon ..	400	284	..	..	50	29	5	32	9·3	*154*	*7·6*
Bury St. Edmunds :	451	327	1	..	23	50	22	28	11·1	*168*	*8·0*
Cosford	404	340	..	..	14	35	7	8	3·7	*70*	*3·0*
Hartismere	323	245	1	..	12	38	4	23	8·4	*141*	*7·5*
Hoxne	299	269	..	..	4	21	..	5	1·7	*60*	*3·8*
Ipswich	1,881	403	1	..	207	281	34	935	52·1	*4,172*	*47·2*
Mildenhall	215	185	1	..	2	22	1	4	2·3	*34*	*2·9*
Mutford and Lothingland	1,295	857	3	..	23	147	12	253	20·5	*580*	*9·5*
Plomesgate	475	402	..	..	22	31	9	11	4·2	*179*	*6·8*
Risbridge	415	331	..	..	21	45	5	13	4·3	*95*	*3·9*
Samford	327	279	2	..	10	27	5	4	2·8	*59*	*3·4*
Stow	527	408	1	..	43	47	6	22	5·3	*94*	*3·4*
Sudbury	696	574	..	..	29	64	9	20	4·2	*311*	*8·4*
Thingoe	382	324	..	..	12	25	4	17	5·5	*70*	*3·3*
Wangford	386	325	1	..	7	41	4	8	3·1	*41*	*2·1*
Woodbridge	580	457	2	..	17	41	6	57	10·9	*294*	*9·2*
	9,642	6,554	16	..	508	987	135	1,442	16·4	*6,642*	*13·3*

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SURREY (EXTRA METROPOLITAN).											
Chertsey	946	693	3	..	6	71	8	165	18·3	*1,061*	*24·3*
Croydon	4,387	1,911	11	..	86	486	99	1,794	43·2	*6,931*	*33·5*
Dorking	364	210	..	..	60	42	12	40	14·3	*280*	*14·7*
Epsom	1,243	742	3	..	45	114	42	297	27·3	*1,018*	*17·5*
Farnham	1,540	1,204	2	..	15	170	8	141	9·7	*938*	*11·6*
Godstone	617	367	2	..	9	72	16	151	27·1	*385*	*15·9*
Guildford	1,432	970	4	..	119	141	60	138	13·8	*1,313*	*18·6*
Hambledon	505	443	..	..	6	29	8	19	5·3	*103*	*4·1*
Kingston	3,264	2,181	29	..	37	312	133	572	21·6	*2,052*	*13·6*
Reigate	918	565	..	..	53	83	6	211	23·6	*970*	*21·8*
Richmond..	1,018	834	2	..	11	117	2	52	5·3	*171*	*3·3*
	16,234	10,120	56	..	447	1,637	394	3,580	24·5	*15,222*	*19·6*
SUSSEX.											
Battle	506	328	..	..	9	42	10	117	25·1	*675*	*27·0*
Brighton	2,622	1,793	8	..	29	362	80	350	16·4	*1,375*	*10·4*
Chichester	258	200	..	..	8	23	5	22	10·5	*51*	*4·7*
Cuckfield	539	433	2	..	24	36	9	35	8·2	*291*	*10·0*
Eastbourne	1,110	155	..	..	123	132	14	686	63·1	*3,776*	*69·1*
East Grinstead	428	151	..	..	11	31	4	231	54·9	*1,181*	*46·4*
East Preston	829	632	6	..	20	74	29	68	11·7	*348*	*8·5*
Hailsham	405	247	1	..	70	27	12	48	14·8	*312*	*15·6*
Hastings	1,331	960	8	..	83	140	11	129	10·5	*1,420*	*20·2*
Horsham	683	549	1	..	37	43	15	38	7·8	*382*	*12·1*
Lewes	490	175	..	..	163	35	11	106	23·9	*788*	*48·4*
Midhurst	327	283	1	..	8	22	4	9	4·0	*78*	*4·4*
Newhaven	291	189	3	..	21	33	5	40	15·5	*164*	*11·4*
Petworth	217	190	..	..	5	19	..	3	1·4	*33*	*2·9*
Rye	271	196	1	..	25	13	5	11	5·9	*146*	*9·5*
Steyning	1,685	1,251	10	..	28	149	14	233	14·7	*509*	*6·4*
Thakeham	184	153	..	..	1	8	5	17	12·0	*28*	*3·0*
Ticehurst	375	287	..	..	25	20	9	34	11·5	*331*	*15·7*
Uckfield	561	216	..	..	163	53	8	121	23·0	*1,319*	*44·5*
Westbourne	167	143	..	..	2	10	..	12	7·2	*63*	*6·9*
Westhampnett	449	380	3	..	5	36	5	20	5·6	*210*	*8·2*
	13,728	8,911	44	..	860	1,328	255	2,330	18·8	*13,480*	*19·5*
WARWICK.											
Alcester	572	455	1	..	44	58	2	12	4·5	*212*	*7·8*
Aston	10,274	6,888	53	..	41	1,496	129	1,667	17·5	*6,491*	*13·9*
Atherstone	643	270	..	..	39	85	1	248	38·7	*875*	*30·3*
Birmingham	8,347	5,900	39	..	31	1,157	54	1,166	14·6	*3,153*	*7·8*
Coventry	1,924	357	1	..	186	312	108	960	55·5	*5,865*	*69·5*
Foleshill	919	638	..	..	90	127	..	64	7·0	*1,565*	*43·3*
Meriden	251	168	..	..	4	25	4	50	21·5	*186*	*14·0*
Nuneaton..	932	169	1	..	62	158	..	542	58·2	*2,902*	*74·2*
Rugby	887	91	1	..	16	87	5	687	78·0	*2,014*	*51·1*
Solihull	1,112	711	5	..	15	119	3	259	23·6	*689*	*15·3*
Southam	283	180	..	..	11	20	12	60	25·4	*187*	*12·8*
Stratford-on-Avon ..	450	270	3	..	35	55	2	85	19·3	*266*	*10·1*
Warwick	1,161	907	2	..	19	114	23	96	10·2	*538*	*8·7*
	27,755	17,004	106	..	593	3,813	343	5,896	22·5	*24,943*	*19·3*

	RETURNS, 1898.									Children remaining "unaccounted for" when the Returns for the several Years were received.	
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TMORLAND.											
ırd	331	240	..	..	25	40	5	21	7·9	*112*	*6·6*
.. .. ..	1,017	910	1	..	14	66	10	16	2·6	*167*	*3·1*
ard	193	170	..	..	2	16	2	3	2·6	*41*	*4·1*
	1,541	1,320	1	..	41	122	17	40	3·7	*320*	*3·9*
WILTS.											
ry..	143	118	1	..	7	7	1	9	7·0	*58*	*7·0*
d-on-Avon ..	244	96	..	..	16	20	..	112	45·9	*258*	*20·6*
.. .. ..	204	91	..	..	30	25	28	30	28·4	*373*	*35·1*
ıham	613	138	..	..	7	38	4	426	70·1	*880*	*30·5*
le & Wootton t.	319	124	..	..	98	20	11	66	24·1	*790*	*46·3*
.. .. ..	469	245	1	..	91	25	50	57	22·8	*634*	*26·2*
bury	342	156	..	..	14	28	5	139	42·1	*365*	*22·8*
ough	195	165	..	..	6	16	3	5	4·1	*29*	*2·7*
.. .. ..	131	117	..	..	3	2	6	3	6·9	*52*	*6·3*
.. .. ..	316	259	..	..	10	23	3	21	7·6	*62*	*4·1*
y	685	449	4	..	82	67	26	57	12·1	*228*	*6·5*
ı and High- .	1,730	284	5	..	666	174	80	521	34·7	*4,757*	*57·1*
.. .. ..	213	154	..	..	..	15	2	42	20·7	*95*	*9·0*
idge and Melk-	431	66	1	..	160	40	..	164	38·1	*1,147*	*52·6*
ster	300	228	1	..	30	14	2	25	9·0	*251*	*16·3*
ry and Whor- lown.	211	66	..	..	14	16	2	113	54·5	*259*	*21·0*
.. .. ..	225	155	1	..	32	18	11	8	8·4	*88*	*7·1*
	6,771	2,911	14	..	1,266	548	234	1,798	30·0	*10,326*	*30·2*
RCESTER.											
rove	986	796	4	..	24	86	13	63	7·7	*359*	*7·6*
ch	470	375	..	..	4	45	2	44	9·8	*155*	*6·1*
.. .. ..	5,560	4,094	15	..	55	696	78	622	12·6	*2,629*	*9·5*
n	472	288	3	..	116	39	1	25	5·5	*403*	*16·4*
ninster	968	803	4	..	35	96	7	23	3·1	*177*	*3·4*
Iorton	4,947	2,850	20	..	106	560	81	1,330	28·5	*4,842*	*23·1*
.. .. ..	440	314	1	..	10	30	2	83	19·3	*140*	*6·4*
e	358	307	..	..	14	24	1	12	3·6	*48*	*2·8*
ı-on-Stour ..	342	262	1	..	15	23	11	30	12·0	*190*	*9·3*
idge	3,069	2,583	13	..	36	327	29	78	3·5	*386*	*2·5*
r	199	169	..	..	2	15	5	8	6·5	*83*	*8·4*
n-Severn ..	510	428	1	..	17	30	14	20	6·7	*165*	*6·2*
er	1,286	915	6	..	17	148	57	143	15·6	*1,266*	*19·2*
	19,607	14,187	68	..	451	2,119	301	2,481	14·2	*10,843*	*11·4*
EAST RIDING.											
r	725	559	5	..	36	90	4	31	4·8	*262*	*7·2*
ton	489	334	8	..	6	67	3	71	15·1	*438*	*18·2*
.. .. ..	478	364	4	..	16	61	16	17	6·9	*102*	*4·0*
.. .. ..	348	288	..	..	3	41	3	13	4·6	*88*	*4·9*
ı-upon-Hull ..	2,675	1,415	5	..	113	373	42	727	28·7	*2,220*	*17·5*
on	185	144	..	..	9	18	1	13	7·6	*90*	*8·6*
rton	371	299	2	..	4	48	..	18	4·9	*62*	*3·2*
es	5,323	3,906	18	..	394	633	54	318	7·0	*3,598*	*14·4*
h	234	189	..	..	2	25	1	17	7·7	*68*	*5·6*
.. .. .	2,584	1,971	16	..	36	294	35	232	10·3	*909*	*7·2*
	13,412	9,469	58	..	619	1,650	159	1,457	12·0	*7,837*	*12·1*

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York, North Riding.											
Aysgarth	104	93	..	..	..	7	..	4	3·8	*19*	*3·2*
Bedale	228	197	5	..	1	13	1	11	5·3	*35*	*3·2*
Easingwold	260	198	..	..	1	28	2	31	12·7	*68*	*5·7*
Guisborough	1,375	1,090	4	..	32	139	41	69	8·0	*429*	*7·4*
Helmsley	106	96	..	..	2	6	1	1	1·9	*59*	*9·0*
Kirkby Moorside ..	112	87	..	1	2	18	2	2	3·6	*61*	*8·6*
Leyburn	163	147	1	..	..	12	..	3	1·8	*19*	*2·3*
Malton	567	429	1	..	17	55	18	47	11·5	*270*	*9·3*
Middlesbrough	4,549	3,433	23	1	57	602	109	324	9·5	*1,346*	*6·2*
Northallerton	319	278	1	..	3	25	3	9	3·8	*43*	*2·9*
Pickering	280	219	6	..	13	23	12	7	6·8	*165*	*10·2*
Reeth	63	55	..	..	..	5	..	3	4·8	*26*	*7·9*
Richmond	289	234	..	..	1	28	..	26	9·0	*137*	*8·4*
Scarborough	1,307	342	2	..	542	152	4	265	20·6	*3,545*	*56·9*
Stokesley	287	240	..	..	2	23	7	15	7·7	*59*	*3·5*
Thirsk	319	234	..	..	1	33	5	46	16·0	*44*	*2·7*
Whitby	561	457	1	..	23	60	10	10	3·6	*185*	*6·3*
	10,889	7,829	44	2	697	1,229	215	873	10·0	*6,503*	*19·3*
York, West Riding.											
Barnsley	4,172	3,168	22	..	37	579	33	333	8·8	*1,791*	*8·3*
Bierley, North	3,485	2 074	10	..	170	417	54	760	23·4	*5,158*	*28·0*
Bradford	5,336	2,249	..	..	158	760	56	2,113	40·6	*8,202*	*29·5*
Bramley	2,300	1,330	21	..	21	305	7	616	27·1	*2,090*	*18·4*
Dewsbury	4,551	1,577	6	..	598	681	108	1,581	37·1	*11,987*	*51·4*
Doncaster	2,763	1,968	10	..	124	390	52	219	9·8	*1,685*	*13·8*
Ecclesall Bierlow ..	4,907	3,771	114	..	83	589	37	313	7·1	*1,093*	*4·6*
Goole	895	685	5	..	8	114	9	74	9·3	*470*	*10·6*
Halifax	4,536	458	6	..	193	625	..	3,254	71·7	*18,795*	*82·1*
Hemsworth	753	564	1	..	6	94	29	59	11·7	*330*	*9·6*
Holbeck	1,074	809	2	..	6	144	30	83	10·5	*277*	*5·7*
Huddersfield	4,076	3,317	39	..	83	361	18	258	6·8	*554*	*2·8*
Hunslet	2,614	2,032	16	..	25	356	48	137	7·1	*743*	*5·6*
Keighley	1,949	119	1	..	1,143	88	..	598	30·7	*7,311*	*75·7*
Knaresborough	915	438	2	..	48	121	36	270	33·4	*1,248*	*32·0*
Leeds	7,634	5,748	71	..	99	904	119	693	10·6	*2,446*	*6·7*
Ouseburn, Great ..	245	206	1	..	4	24	..	10	4·1	*43*	*2·8*
Pateley Bridge	215	120	1	..	2	30	1	61	28·8	*122*	*10·7*
Penistone	490	385	1	..	7	40	24	33	11·6	*163*	*6·5*
Pontefract	2,476	1,799	21	..	54	344	41	217	10·4	*858*	*7·1*
Ripon	355	316	..	..	3	24	5	7	3·4	*286*	*14·6*
Rotherham	3,772	3,046	18	..	29	466	14	199	5·6	*1,293*	*7·0*
Saddleworth	432	151	..	..	199	48	4	30	7·9	*1,695*	*65·5*
Sedbergh	71	68	..	..	..	2	..	1	1·4	*16*	*3·4*
Selby	439	370	1	..	3	52	3	10	3·0	*103*	*4·6*
Settle	355	254	..	..	33	34	12	22	9·6	*260*	*14·7*
Sheffield	8,040	5,898	132	..	93	1,181	90	646	9·2	*3,553*	*9·1*
Skipton	1,259	336	1	..	555	160	27	180	16·4	*3,052*	*52·7*
Tadcaster	952	756	3	..	16	107	10	60	7·4	*255*	*5·5*
Thorne	428	265	..	..	23	53	11	76	20·3	*365*	*17·0*
Wakefield	3,601	2,884	10	..	49	449	28	181	5·8	*1,355*	*7·5*
Wetherby	364	312	2	..	3	25	7	15	6·0	*146*	*7·9*
Wharfedale	1,412	875	1	..	81	126	11	318	23·3	*1,337*	*19·1*
Wortley	1,602	1,275	10	..	9	173	43	92	8·4	*722*	*9·4*
	78,468	49,623	528	..	3,965	9,866	967	13,519	18·5	*79,804*	*20·6*

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ANGLESEY.											
Anglesey	355	317	..	..	8	19	2	9	3·1	*63*	*3·6*
Holyhead	539	463	..	..	..	42	14	20	6·3	*141*	*5·4*
	894	780	..	..	8	61	16	29	5·0	*204*	*4·7*
BRECKNOCK.											
Brecknock	401	352	2	..	..	35	4	8	3·0	*53*	*2·6*
Builth	232	198	..	..	1	21	5	7	5·2	*50*	*4·6*
Crickhowell	674	424	..	..	3	40	23	184	30·7	*434*	*12·8*
Hay	267	196	1	..	14	23	13	20	12·4	*244*	*19·2*
	1,574	1,170	3	..	18	119	45	219	16·8	*781*	*10·1*
CARDIGAN.											
Aberayron	239	196	..	..	..	25	9	9	7·5	*43*	*3·1*
Aberystwith	528	443	..	..	4	57	10	15	4·7	*131*	*5·5*
Cardigan	348	282	..	..	9	29	..	28	8·0	*291*	*15·9*
Lampeter	191	163	..	..	..	23	..	5	2·6	*23*	*2·1*
Tregaron	211	186	..	..	..	21	..	4	1·9	*22*	*2·2*
	1,517	1,269	..	..	13	155	19	61	5·3	*510*	*6·6*
CARMARTHEN.											
Carmarthen	860	756	..	..	3	96	..	5	0·6	*103*	*2·3*
Llandilo Fawr	698	607	..	..	..	74	9	8	2·4	*113*	*3·3*
Llandovery	214	190	..	..	..	19	3	2	2·3	*37*	*2·7*
Llanelly	1,769	1,509	1	..	2	194	31	32	3·0	*494*	*5·3*
Newcastle-in-Emlyn ..	450	370	..	..	1	48	7	24	6·9	*63*	*2·8*
	3,991	3,432	1	..	6	431	50	71	3·0	*810*	*3·9*
CARNARVON.											
Bangor and Beaumaris	950	802	2	..	3	118	10	15	2·6	*188*	*3·8*
Carnarvon	1,202	921	..	..	..	167	20	94	9·5	*550*	*10·2*
Conway	784	580	..	..	1	85	4	114	15·1	*242*	*6·8*
Pwllheli	484	334	3	..	2	51	36	58	19·4	*155*	*6·2*
	3,420	2,637	5	..	6	421	70	281	10·3	*1,136*	*6·9*
DENBIGH.											
Llanrwst	338	255	..	..	7	24	..	52	15·4	*123*	*7·9*
Ruthin	284	243	..	..	..	29	5	7	4·2	*44*	*2·9*
Wrexham . ..	2,381	1,971	4	..	4	294	31	77	4·5	*558*	*4·8*
	3,003	2,469	4	..	11	347	36	136	5·7	*725*	*4·9*

—	Returns, 1898. Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Number in respect of whom Certificates of conscientious objection have been received.	Died unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of births.	*Children remaining "unaccounted for" when the Returns for the several Years were received.* *Total number for the Years 1893–97.*	*Average percentage for the Years 1893–97.*
FLINT.											
Asaph, St.	756	595	2	..	2	104	11	42	7·0	*270*	*7·5*
Hawarden	518	452	4	..	1	48	6	7	2·5	*345*	*13·8*
Holywell	1,194	987	..	..	3	112	45	47	7·7	*405*	*6·5*
	2,468	2,034	6	..	6	264	62	96	6·4	*1,020*	*8·3*
GLAMORGAN.											
Bridgend and Cowbridge	2,134	1,709	5	..	6	241	83	90	8·1	*518*	*5·1*
Cardiff	7,751	5,593	31	..	107	863	62	1,095	14·9	*2,957*	*8·2*
Gower	311	259	2	..	1	24	5	20	8·0	*179*	*11·9*
Merthyr Tydfil	4,607	3,667	7	..	14	623	269	117	8·2	*1,395*	*5·8*
Neath	2,469	2,106	10	..	12	236	38	67	4·3	*328*	*2·8*
Pontardawe	946	833	..	..	1	93	9	10	2·0	*97*	*2·2*
Pontypridd	7,278	5,347	9	..	20	959	173	770	13·0	*2,246*	*6·3*
Swansea	3,756	3,123	1	..	9	409	2	212	5·7	*1,063*	*5·3*
	29,342	22,637	65	..	170	3,448	641	2,381	10·3	*8,783*	*6·1*
MERIONETH.											
Bala	131	107	..	..	2	11	6	5	8·4	*48*	*7·2*
Corwen	455	384	..	..	2	46	11	12	5·1	*146*	*6·9*
Dolgelley	370	311	..	..	1	45	7	6	3·5	*48*	*2·8*
Festiniog	886	485	..	..	..	107	24	270	33·2	*200*	*5·0*
	1,842	1,287	..	..	5	209	48	293	18·5	*442*	*5·2*
MONTGOMERY.											
Forden	361	318	..	..	5	31	3	4	1·9	*100*	*5·1*
Llanfyllin	428	375	1	..	1	35	9	7	3·7	*72*	*3·2*
Machynlleth	282	246	..	..	1	17	8	10	6·4	*46*	*3·5*
Newtown and Llanidloes	608	485	2	..	3	56	8	54	10·2	*198*	*7·0*
	1,679	1,424	3	..	10	139	28	75	6·1	*416*	*5·0*
PEMBROKE.											
Haverfordwest	930	676	1	..	..	112	16	125	15·2	*603*	*10·7*
Narberth	422	373	..	..	1	40	2	6	1·9	*84*	*3·8*
Pembroke	873	721	..	..	3	75	45	29	8·5	*184*	*4·3*
	2,225	1,770	1	..	4	227	63	160	10·0	*771*	*6·9*
RADNOR.											
Knighton	340	195	1	..	3	26	9	106	33·8	*820*	*51·9*
Rhayader	251	153	..	..	2	20	1	75	30·3	*165*	*16·4*
	591	348	1	..	5	46	10	181	32·3	*985*	*38·1*

No. 1A.

[*This digest, which is subject to correction, was able to be inserted just before the volume went to press.*]

DIGEST of the VACCINATION OFFICERS' RETURNS with regard to Children whose Births were registered in the Year 1899.

The following is a summary of the twenty-eighth annual return under the Vaccination Act, 1871 :—Of 929,189 births returned to the Board by the several vaccination officers in England and Wales as registered during the year 1899, the number which, at the time the return was made, had been registered as successfully vaccinated was 617,113 (being 66·4 per cent. of the whole), and the number registered as having died unvaccinated was 113,516 (or 12·2 per cent. of the whole). Of the remaining 198,560 children, 5,379 (or 0·6 per cent. of the whole) had been registered as insusceptible of vaccination : 4 as having contracted small-pox; 16,605 (or 1·8 per cent.) as having their vaccination postponed by medical certificate; and 33,573 (or 3·6 per cent.) in respect of whom certificates of conscientious objection were received; leaving 142,999 (or 15·6 per cent.) as "removed" "not to be traced" or otherwise unaccounted for. If from the 929,189 births returned by these officers deduction be first made of the deaths that took place before vaccination, it appears that, of the surviving 815,673 children, there were registered at the time of the return 75·7 per cent. as successfully vaccinated: 0·7 per cent. as either insusceptible of vaccination, or as having had small-pox; 2 per cent. as under medical certificate of postponement; and 4·1 per cent. in respect of whom certificates of conscientious objection to vaccination had been obtained; leaving 17·5 per cent. as at that time still unaccounted for as regards vaccination.

The proportion of cases un-accounted for in the metropolitan returns for 1899 is 27·7 per cent.; in the provincial returns 15·4. Of the registered births of the twenty-eight years, 1872–99; the

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Digest of Vaccination Officers' Returns, 1899.

proportion not finally accounted for in regard to vaccination (including cases postponed) in each year respectively has been as follows :—

—	Metropolis.	Rest of England.	—	Metropolis.	Rest of England.
1872	8·8	4·5	1886	7·8	6·1
1873	8·7	4·2	1887	9·0	6·7
1874	8·8	4·1	1888	10·3	8·2
1875	9·3	3·8	1889	11·6	9·6
1876	6·5	4·0	1890	13·9	10·9
1877	7·1	4·1	1891	16·4	12·9
1878	7·1	4·3	1892	18·4	14·3
1879	7·8	4·5	1893	18·2	15·7
1880	7·0	4·5	1894	20·6	19·0
1881	5·7	4·3	1895	24·9	19·8
1882	6·6	4·5	1896	26·4	22·3
1883	6·5	4·9	1897	29·1	21·6
1884	6·8	5·3	1898	33·0	19·6
1885	7·0	5·5	1899	27·7	15·4

In 1899, the proportion of cases unaccounted for, after deduction of the postponed cases in the Metropolis, and in the rest of England, was 26·0 and 13·6 per cent. respectively.

—	Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Number in respect of whom Certificates of Conscientious Objection have been received.	Died unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of births. 1899.	1898.	Total number of Certificates of Successful Primary Vaccination at ALL AGES received during each of the calendar years, 1899 and 1900. 1899.	1900.
ENGLAND AND WALES	929,189	617,113	5,379	4	33,573	113,516	16,605	142,999	17·2	21·5	696,151	677,655
DIVISIONS.												
London	133,152	78,248	785	—	1,362	15,905	2,189	34,663	27·7	33·0	89,941	90,261
South Eastern	80,324	57,594	478	2	3,242	8,253	1,413	9,342	13·4	17·2	63,818	63,453
South Midland	56,943	34,497	270	—	4,149	5,951	754	11,322	21·2	26·1	40,767	37,775
Eastern	52,279	34,272	238	—	2,924	5,757	1,116	7,972	17·4	25·3	36,915	36,200
South Western	47,000	32,821	229	—	2,536	4,745	1,147	5,522	14·3	19·6	37,387	35,894
West Midland	111,161	73,862	736	—	2,924	13,997	2,054	17,588	17·7	23·1	84,540	78,859
North Midland	59,898	29,199	275	—	5,296	8,105	1,296	15,727	28·4	31·7	36,266	32,974
North Western	154,423	109,417	966	—	4,884	21,057	2,315	15,784	11·7	15·3	122,186	124,635
York	103,531	72,941	886	2	3,419	12,469	1,557	12,257	13·3	16·7	84,436	77,487
Northern	69,296	47,824	354	—	2,075	9,137	1,753	8,153	14·3	18·8	51,371	50,305
Wales..	61,182	46,438	162	—	762	8,140	1,011	4,669	9·3	11·1	48,524	49,812

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Digest of Vaccination Officers' Returns. 1899.

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Digest of Vaccination Officers' Returns, 1899.

—	Returns, 1899.									Total number of Certificates of successful Primary Vaccination at ALL AGES received during each of the calendar years, 1899 and 1900.	
	Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Number in respect of whom Certificates of conscientious objection have been received.	Died unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of births	1899.	1900.
II.—South Eastern.											
Surrey (extra Metropolitan).	16,969	11,158	81	—	519	1,725	482	3,004	20·5	12,301	12,576
Kent (extra Metropolitan)	23,568	17,882	173	—	998	2,438	369	1,708	8·8	20,181	19,735
Sussex	13,867	9,205	72	—	976	1,383	262	1,969	16·1	10,213	10,116
Hampshire	19,010	14,993	129	2	500	2,005	231	1,150	7·3	16,157	16,711
Berkshire	6,910	4,356	23	—	249	702	69	1,511	22·9	4,966	4,315
	80,324	57,594	478	2	3,242	8,253	1,413	9,342	13·4	63,818	63,453
III.—South Midland.											
Middlesex (extra Metropolitan).	20,623	13,531	149	—	323	2,363	260	3,997	20·6	14,867	15,208
Hertfordshire	7,047	5,153	38	—	367	599	142	748	12·6	5,386	5,507
Buckinghamshire ..	4,391	2,855	12	—	682	382	72	388	10·5	4,358	2,825
Oxfordshire..	4,544	3,391	18	—	457	375	36	267	6·7	4,806	4,131
Northamptonshire ..	9,805	3,284	19	—	1,260	1,130	104	4,008	41·9	3,874	3,446
Huntingdonshire	1,217	999	5	—	54	107	6	46	4·3	1,226	984
Bedfordshire	4,330	1,435	7	—	784	528	34	1,542	36·4	1,771	1,397
Cambridgeshire	4,986	3,849	22	—	222	467	100	326	8·5	4,679	4,277
	56,943	34,497	270	—	4,149	5,951	754	11,322	21·2	40,767	37,775
IV.—Eastern.											
Essex	30,109	18,423	154	—	898	3,373	861	6,400	24·1	20,254	20,264
Suffolk	9,527	7,189	32	—	449	931	147	779	9·7	7,559	7,153
Norfolk	12,643	8,660	52	—	1,577	1,453	108	793	7·1	9,102	8,783
	52,279	34,272	238	—	2,924	5,757	1,116	7,972	17·4	36,915	36,200

—	Returns, 1899. Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Number in respect of whom Certificates of conscientious objection have been received.	Died unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of births.	Total number of Certificates of successful Primary Vaccination at ALL AGES received during each of the calendar years, 1899 and 1900. 1899.	1900.
-SOUTH WESTERN.											
hire	6,724	3,853	29	—	1,005	584	165	1,088	18·6	4,366	4,075
tshire	4,805	3,746	12	—	162	324	68	493	11·7	4,293	4,008
nshire	16,328	12,216	101	—	269	1,811	397	1,534	11·8	12,304	12,654
wall	7,755	5,454	33	—	175	890	149	1,054	15·5	7,634	6,935
rsetshire	11,388	7,552	54	—	925	1,136	368	1,353	15·1	8,790	8,222
	47,000	32,821	229	—	2,536	4,745	1,147	5,522	14·3	37,387	35,894
—WEST MIDLAND.											
estershire	17,325	9,303	106	—	1,204	1,955	566	4,191	27·5	10,927	10,278
fordshire	2,805	2,266	11	—	66	250	68	144	7·6	2,361	2,339
pshire	6,722	5,508	23	—	90	628	84	389	7·0	6,578	5,861
rdshire	35,912	23,551	227	—	657	4,927	749	5,801	18·2	28,744	24,451
estershire	20,215	15,038	171	—	387	2,276	357	1,986	11·6	15,808	15,943
rickshire	28,182	18,196	198	—	520	3,961	230	5,077	18·8	20,122	19,987
	111,161	73,862	736	—	2,924	13,997	2,054	17,588	17·7	81,540	78,859
—NORTH MIDLAND.											
stershire	12,852	2,443	11	—	1,966	1,933	156	6,343	50·6	3,194	3,043
ndshire	489	421	6	—	27	29	—	6	1·2	510	427
lnshire	13,339	8,703	96	—	1,477	1,603	279	1,181	10·9	11,225	9,924
nghamshire	18,549	10,100	115	—	1,300	2,690	562	3,782	23·4	11,918	11,799
yshire	14,669	7,532	47	—	526	1,850	299	4,415	32·1	9,419	7,781
	59,898	29,199	275	—	5,296	8,105	1,296	15,727	28·4	36,266	32,974
.—NORTH WESTERN.											
hire	21,498	17,411	146	—	284	2,487	349	821	5·4	18,840	18,895
shire	132,925	92,006	820	—	4,600	18,570	1,966	14,963	12·7	103,346	105,740
	154,423	109,417	966	—	4,884	21,057	2,315	15,784	11·7	122,186	124,635

—	Returns, 1899. Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Number in respect of whom Certificates of conscientious objection have been received.	Died unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of births.	Total number of Certificates of successful Primary Vaccination at ALL AGES received during each of the calendar years, 1899 and 1900. 1899.	1900.
IX.—York.											
West Riding	78,856	54,387	737	—	2,870	9,599	1,164	10,099	14·3	60,572	58,665
East Riding (with York)	13,659	10,459	85	2	142	1,491	143	1,337	10·8	15,045	10,562
North Riding	11,016	8,095	64	—	407	1,379	250	821	9·7	8,819	8,260
	103,531	72,941	886	2	3,419	12,469	1,557	12,257	13·3	84,436	77,487
X.—Northern.											
Durham	40,981	27,936	238	—	1,134	5,624	1,074	4,975	14·8	30,761	29,345
Northumberland	19,120	13,126	93	—	468	2,613	432	2,388	14·7	12,998	14,228
Cumberland	7,659	5,478	16	—	418	765	228	754	12·8	6,132	5,414
Westmorland .. .	1,536	1,284	7	—	55	135	19	36	3·6	1,480	1,318
	69,296	47,824	354	—	2,075	9,137	1,753	8,153	14·3	51,371	50,305
XI.—Welsh.											
Monmouthshire	9,922	6,914	29	—	430	1,314	262	973	12·4	7,782	7,567
South Wales .. .. } North Wales .. .. }	51,260	39,524	133	—	332	6,826	749	3,696	8·7	40,742	42,245
	61,182	46,438	162	—	762	8,140	1,011	4,669	9·3	48,524	49,812

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Digest of Vaccination Officers' Returns, 1899

—	Returns, 1899. Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Number in respect of whom Certificates of conscientious objection have been received.	Died Unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed) per cent. of births.	Total number of Certificates of successful Primary Vaccination at ALL AGES received during each of the calendar years 1899 and 1900. 1899.	1900.
ENGLAND AND WALES.	929,189	617,113	5,379	4	33,573	113,516	16,605	142,999	17·2	696,151	677,655
Ditto (excluding Metropolitan Unions).	796,037	538,865	4,594	4	32,211	97,611	14,416	108,336	15·4	606,210	587,394
METROPOLITAN UNIONS.	133,152	78,248	785	..	1,362	15,905	2,189	34,663	27·7	89,941	90,261
COUNTIES.											
ENGLAND:											
Bedford	4,330	1,435	7	..	784	528	31	1,542	36·4	1,771	1,397
Berks	6,910	4,356	23	..	249	702	69	1,511	22·9	4,966	4,315
Bucks	4,391	2,855	12	..	682	382	72	388	10·5	4,358	2,825
Cambridge ..	4,986	3,849	22	..	222	467	100	326	8·5	4,679	4,277
Chester	21,498	17,411	146	..	284	2,487	349	821	5·4	18,840	18,895
Cornwall ..	7,755	5,454	33	..	175	890	149	1,054	15·5	7,634	6,935
Cumberland ..	7,659	5,478	16	..	418	765	228	754	12·8	6,132	5,414
Derby	14,669	7,532	47	..	526	1,850	299	4,415	32·1	9,419	7,781
Devon	16,328	12,216	101	..	269	1,811	397	1,534	11·8	12,304	12,654
Dorset	4,805	3,746	12	..	102	324	68	493	11·7	4,293	4,008
Durham. ..	40,981	27,936	238	..	1,134	5,624	1,074	4,975	14·8	30,761	29,345
Essex	30,109	18,423	154	..	898	3,373	861	6,400	24·1	20,254	20,264
Gloucester ..	17,325	9,303	106	..	1,204	1,955	566	4,191	27·5	10,927	10,278
Hereford ..	2,805	2,266	11	..	66	250	68	144	7·6	2,361	2,339
Hertford ..	7,047	5,153	38	..	367	599	142	748	12·6	5,386	5,507
Huntingdon ..	1,217	999	5	..	54	107	6	46	4·3	1,226	984
Kent (extra-metropolitan.)	23,568	17,882	173	..	998	2,438	369	1,708	8·8	20,181	19,735
Lancaster ..	132,925	92,006	820	..	4,600	18,570	1,966	14,963	12·7	103,346	105,740
Leicester ..	12,852	2,443	11	..	1,966	1,933	156	6,343	50·6	3,191	3,043
Lincoln	13,339	8,703	96	..	1,477	1,603	279	1,181	10·9	11,225	9,924
Middlesex (ex-metropolitan.)	20,623	13,531	149	..	323	2,363	260	3,997	20·6	14,667	15,208
Monmouth ..	9,822	6,914	29	..	430	1,314	262	973	12·4	7,782	7,567
Norfolk	12,643	8,660	52	..	1,577	1,453	108	793	7·1	9,102	8,783
Northampton ..	9,805	3,284	19	..	1,260	1,130	104	4,008	41·9	3,874	3,446
Northumberland	19,120	13,126	93	..	468	2,613	432	2,388	14·7	12,998	14,228

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Digest of Vaccination Officers' Returns, 1899.

—	Returns, 1899.									Total number of Certificates of successful Primary Vaccination at ALL AGES received during each of the calendar years 1899 and 1900.	
	Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Number in respect of whom Certificates of conscientious objection have been received.	Died Unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed) per cent. of births.	1899.	1900.
COUNTIES—*cont.*											
ENGLAND—*cont.*											
Nottingham ..	18,549	10,100	115	..	1,300	2,690	562	3,782	23·4	11,918	11,799
Oxford	4,544	3,391	18	..	457	375	36	267	6·7	4,806	4,131
Rutland	489	421	6	..	27	29	..	6	1·2	510	427
Salop	6,722	5,508	23	..	90	628	84	389	7·0	6,578	5,861
Somerset ..	11,388	7,552	54	..	925	1,136	368	1,353	15·1	8,790	8,222
Southampton ..	19,010	14,993	129	2	500	2,005	231	1,150	7·3	16,157	16,711
Stafford	35,912	23,551	227	..	657	4,927	749	5,801	18·2	28,744	24,451
Suffolk	9,527	7,189	32	..	449	931	147	779	9·7	7,559	7,153
Surrey (extra-metropolitan.)	16,969	11,158	81	..	519	1,725	482	3,004	20·5	12,301	12,576
Sussex	13,867	9,205	72	..	976	1,383	262	1,969	16·1	10,213	10,116
Warwick ..	28,182	18,196	198	..	520	3,961	230	5,077	18·8	20,122	19,987
Westmorland ..	1,536	1,284	7	..	55	135	19	36	3·6	1,480	1,318
Wilts	6,724	3,853	29	..	1,005	584	165	1,088	18·6	4,366	4,075
Worcester ..	20,215	15,038	171	..	387	2,276	357	1,986	11·6	15,808	15,943
York, E. Riding	13,659	10,459	85	2	142	1,491	143	1,337	10·8	15,045	10,562
York, N. Riding	11,016	8,095	64	..	407	1,379	250	821	9·7	8,819	8,260
York, W. Riding	78,856	54,387	737	..	2,870	9,599	1,164	10,099	14·3	60,572	58,665
WALES:											
Anglesey ..	909	783	..	..	1	97	10	18	3·1	878	609
Brecknock ..	1,496	1,124	1	..	23	167	22	159	12·1	1,182	1,404
Cardigan ..	1,475	1,244	1	..	18	166	19	27	3·1	1,573	1,303
Carmarthen ..	3,984	3,373	4	..	13	511	38	45	2·1	3,228	3,780
Carnarvon ..	3,568	2,956	11	..	18	429	31	123	4·3	3,009	3,235
Denbigh	2,903	2,453	16	..	6	318	39	71	3·8	2,888	2,614
Flint	2,422	2,050	3	..	2	252	47	68	4·7	2,148	1,930
Glamorgan ..	28,369	20,598	87	..	222	4,258	448	2,756	11·3	20,565	22,298
Merioneth ..	1,707	1,356	1	..	6	205	26	113	8·1	1,328	1,348
Montgomery ..	1,649	1,386	5	..	4	166	16	72	5·3	1,485	1,341
Pembroke ..	2,195	1,830	4	..	6	219	49	87	6·2	1,997	1,959
Radnor	583	371	..	..	13	38	4	157	27·6	461	424

	Returns, 1899.									Total number of Certificates of successful Primary Vaccination at ALL AGES received during each of the calendar years 1899 and 1900.	
	Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Number in respect of whom Certificates of conscientious objection have been received.	Died unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of births.	1899.	1900.
Bethnal Green	4,748	1,830	1	..	18	630	17	2,252	47·8	1,967	2,031
Camberwell	7,444	4,477	20	..	84	731	175	1,957	28·6	5,361	4,706
Chelsea	2,382	1,765	24	..	27	238	25	303	13·8	1,978	1,939
Fulham	4,581	3,360	27	..	66	615	76	437	11·2	3,447	3,959
George, St., Hanover Square.	2,458	1,944	21	..	25	272	27	169	8·0	2,073	2,095
George, St., in the East	2,063	1,102	..	..	2	239	..	720	34·9	1,533	1,498
Giles, St., and St. George	1,124	658	6	..	8	89	4	359	32·3	684	632
Greenwich	5,682	4,138	41	..	61	697	70	675	13·1	4,400	4,435
Hackney	7,249	3,506	34	..	68	908	39	2,694	37·7	4,945	4,414
Hammersmith	3,061	2,317	28	..	55	359	30	272	9·9	2,467	2,618
Hampstead	1,577	1,238	37	..	31	140	25	106	8·3	1,351	1,355
Holborn	4,590	2,518	20	..	47	593	125	1,287	30·8	2,496	2,834
Islington	9,651	5,698	81	.	101	1,048	333	2,390	28·2	6,894	6,330
Kensington	3,584	2,804	38	..	31	376	23	312	9·3	3,412	3,187
Lambeth	9,428	5,825	47	..	114	1,174	117	2,149	24·0	7,616	6,571
Lewisham	3,074	2,019	35	..	60	328	7	625	20·6	2,371	2,310
London, City of	430	305	2	..	10	44	7	62	16·0	350	382
Marylebone	3,992	2,721	30	..	28	405	105	703	20·2	3,046	3,218
Mile End Old Town ..	4,276	797	10	..	20	480	..	2,969	69·4	904	1,017
Olave, St.	4,694	2,939	15	..	35	629	..	1,076	22·9	4,135	3,875
Paddington	2,933	2,167	17	..	39	319	47	344	13·3	2,261	2,300
Pancras, St.	6,621	3,333	57	..	61	837	241	2,092	35·2	3,178	3,851
Poplar	5,930	2,113	12	..	28	838	18	2,921	49·6	2,185	2,414
Shoreditch	4,141	1,354	5	..	10	612	136	2,024	52·2	1,565	1,506
Southwark	6,997	3,825	28	..	47	1,024	8	2,065	29·6	4,520	4,296
Stepney	1,937	750	3	..	6	276	8	894	46·6	1,031	944
Strand	350	225	2	..	..	54	7	62	19·7	249	282
Wandsworth and Clapham.	10,715	6,716	96	..	183	1,211	468	2,041	23·4	7,324	8,912
Westminster	708	536	3	..	8	64	2	95	13·7	783	623
Whitechapel	2,998	2,259	16	..	13	288	28	394	14·1	2,211	2,501
Woolwich	3,736	3,009	29	..	76	387	21	214	6·3	3,204	3,226
	133,152	78,248	785	..	1,362	15,905	2,189	34,663	27·7	89,941	90,261

—	Returns, 1899. Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Number in respect of whom Certificates of conscientious objection have been received.	Died unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of births.	Total number of Certificates of successful Primary Vaccination at ALL AGES received during each of the calendar years 1899 and 1900. 1899.	1900.
BEDFORD.											
Ampthill	536	328	1	..	69	38	1	99	18·7	393	292
Bedford	1,321	283	3	..	23	181	10	821	62·9	206	253
Biggleswade	695	488	1	..	121	57	4	24	4·0	510	469
Leighton Buzzard ..	431	229	1	..	122	46	6	27	7·7	536	292
Luton	1,347	107	1	..	449	206	13	571	43·4	126	121
	4,330	1,435	7	..	784	528	34	1,542	36·4	1,771	1,397
BERKS											
Abingdon	422	349	..	..	12	57	2	22	5·7	375	348
Bradfield	395	301	2	..	24	33	..	35	8·9	317	310
Easthampstead	323	279	1	..	7	21	1	14	4·6	381	335
Faringdon..	330	251	3	..	4	39	5	28	10·0	251	183
Hungerford and Ramsbury.	429	373	..	..	4	38	5	9	3·3	393	330
Maidenhead	570	399	1	..	70	53	6	41	8·2	599	435
Newbury	458	374	4	..	16	36	10	18	6·1	485	412
Reading	1,888	385	5	..	62	265	5	1,166	62·0	409	361
Wallingford	320	276	2	..	7	22	3	10	4·1	309	310
Wantage	383	317	..	..	10	38	10	8	4·7	400	304
Windsor	997	774	5	..	27	81	15	95	11·0	769	695
Wokingham	395	278	..	..	6	39	7	65	18·2	278	292
	6,910	4,356	23	..	249	702	69	1,511	22·9	4,966	4,315
BUCKINGHAM.											
Amersham	519	306	..	..	93	48	8	64	13·9	457	245
Aylesbury..	608	487	1	..	44	55	11	10	3·5	418	218
Buckingham	242	176	2	..	33	19	4	8	5·0	244	181
Eton	859	678	2	..	20	86	26	47	8·5	725	721
Newport Pagnell ..	723	487	3	..	164	43	2	24	3·6	850	543
Winslow	168	89	2	..	51	12	5	7	7·1	245	139
Wycombe	1,272	632	2	..	275	119	16	228	19·2	1,419	778
	4,391	2,855	12	..	682	382	72	388	10·5	4,358	2,825
CAMBRIDGE.											
Cambridge	868	588	8	..	28	112	5	127	15·2	674	769
Caxton and Arrington	208	169	..	..	20	13	..	6	2·9	217	153
Chesterton	745	626	1	..	29	57	8	24	4·3	753	773
Ely	511	402	7	..	38	41	4	19	4·5	730	514
Linton	253	208	..	..	4	20	7	14	8·3	221	224
Newmarket	871	647	4	..	32	78	51	59	12·6	605	635
North Witchford ..	473	383	..	..	47	32	3	8	2·3	451	354
Whittlesey	245	199	..	..	3	25	5	13	7·3	245	177
Wisbech	812	627	2	..	21	89	17	56	9·0	783	678
	4,986	3,849	22	..	222	467	100	326	8·5	4,679	4,277

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CHESTER											
Birkenhead	4,940	4,181	29	..	4	553	78	95	3·5	4,208	4,254
Bucklow	1,920	1,563	41	..	29	227	20	40	3·1	1,689	1,824
Chester	1,397	1,120	5	..	10	179	23	60	5·9	1,175	1,354
Congleton	923	725	3	..	10	92	35	58	10·1	767	974
Macclesfield	1,446	1,228	6	..	16	151	23	22	3·1	1,447	1,305
Nantwich	2,266	1,724	14	..	87	237	49	155	9·0	1,992	1,975
Northwich	1,746	1,547	9	..	12	161	1	16	1·0	1,664	1,623
Runcorn	1,170	993	7	..	14	129	19	8	2·3	1,062	1,071
Stockport	4,119	2,979	23	..	94	621	82	320	9·8	3,417	3,121
Tarvin	385	336	2	..	3	33	1	10	2·9	400	379
Wirral	1,186	1,015	7	..	5	104	18	37	4·6	1,019	1,015
	21,498	17,411	146	..	284	2,487	349	821	5·4	18,840	18,895
CORNWALL.											
Austell, St.	926	706	9	..	22	115	12	62	8·0	1,092	777
Bodmin	437	351	4	..	4	43	4	31	8·0	351	422
Camelford	196	174	..	..	7	7	..	8	4·1	236	159
Columb Major, St. ..	384	285	4	..	8	41	22	24	12·0	381	393
Falmouth	565	274	1	..	30	84	20	156	31·2	298	1,377
Germans, St.	481	415	3	..	1	42	6	14	4·2	440	464
Helston	487	342	1	..	12	48	9	75	17·2	426	327
Launceston	309	264	1	..	13	22	2	7	2·9	284	265
Liskeard	563	436	1	..	27	46	9	44	9·4	590	440
Penzance	1,272	965	2	..	11	161	19	114	10·5	1,203	998
Redruth	1,195	647	1	..	12	178	29	328	29·9	647	418
Stratton	176	119	..	..	..	16	..	41	23·3	147	129
Truro	764	476	6	..	28	87	17	150	21·9	1,539	766
	7,755	5,454	33	..	175	890	149	1,054	15·5	7,634	6,935
CUMBERLAND.											
Alston-with-Garrigill ..	73	50	..	..	13	5	3	2	6·8	50	17
Bootle	476	397	2	..	2	49	6	20	5·5	489	473
Brampton	216	158	..	..	6	17	10	25	16·2	210	182
Carlisle	1,682	1,437	2	..	21	165	18	39	3·4	1,590	1,630
Cockermouth	2,177	897	5	..	283	225	164	603	35·2	1,007	707
Longtown	169	132	1	..	2	23	..	11	6·5	132	103
Penrith	562	476	1	..	25	51	6	3	1·6	558	476
Whitehaven	1,706	1,434	4	..	52	163	10	43	3·1	1,557	1,335
Wigton	598	497	1	..	14	67	11	8	3·2	539	491
	7,659	5,478	16	..	418	765	228	754	12·8	6,132	5,414
DERBY.											
Ashbourne	576	401	1	..	16	60	11	87	17·0	441	493
Bakewell	836	642	2	..	57	62	13	60	8·7	876	675
Belper	2,166	1,340	13	..	116	244	43	410	20·9	2,026	1,404
Chapel-en-le-Frith ..	634	504	2	..	8	65	15	40	8·7	693	667
Chesterfield	4,697	2,651	13	..	90	616	140	1,187	28·3	2,799	2,632
Derby	3,000	466	4	..	37	493	..	2,000	66·7	784	450
Glossop	612	348	4	..	121	57	31	18	12·9	490	370
Hayfield	338	270	1	..	4	29	5	29	10·1	354	295
Shardlow	1,810	910	7	..	74	224	41	554	32·9	956	795
	14,669	7,532	47	..	526	1,850	299	4,415	32·1	9,419	7,781

APP. A, No. 1A,

Digest of Vaccination Officers' Returns, 1899.

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DEVON.											
Axminster	352	298	..	..	2	29	3	20	6·5	335	289
Barnstaple	1,041	820	6	..	44	102	20	49	6·6	855	831
Bideford	567	449	..	..	22	60	27	9	6·3	437	370
Crediton	388	362	..	..	2	20	1	3	1·0	383	222
Devonport	1,927	1,115	17	..	5	236	88	466	28·7	623	1,513
East Stonehouse ..	500	391	3	..	2	63	6	35	8·2	391	418
Exeter	843	590	11	..	37	126	44	35	9·4	636	716
Holsworthy	232	195	1	..	6	23	3	4	3·0	208	171
Honiton	466	409	2	..	7	39	..	9	1·9	424	398
Kingsbridge	359	311	2	..	8	28	1	9	2·8	356	318
Newton Abbot	1,588	1,291	11	..	43	177	30	36	4·2	1,498	1,325
Okebampton	361	296	1	..	6	31	9	18	7·5	228	183
Plymouth..	3,010	1,681	11	..	13	491	86	728	27·0	1,715	2,151
Plympton St. Mary ..	490	417	2	..	1	47	4	19	4·7	362	327
South Molton	369	328	1	..	..	33	5	2	1·9	323	278
Tavistock	587	505	6	..	29	37	4	6	1·7	609	559
Thomas, St.	1,285	1,047	19	..	16	106	51	46	7·5	1,047	787
Tiverton	699	587	2	..	14	71	10	15	3·6	665	641
Torrington	288	251	1	..	7	18	3	8	3·8	282	237
Totnes	976	873	5	..	5	74	2	17	1·9	927	860
	16,328	12,216	101	..	269	1,811	397	1,534	11·8	12,304	12,654
DORSET.											
Beaminster	251	225	..	..	1	18	3	4	2·8	226	197
Blandford..	264	194	1	..	18	20	16	15	11·7	278	230
Bridport	307	266	1	..	5	28	..	7	2·3	282	253
Cerne	116	101	..	..	3	9	..	3	2·6	109	118
Dorchester	444	334	..	..	14	39	6	51	12·8	428	287
Poole	901	644	5	..	54	94	28	76	11·5	883	902
Shaftesbury	259	221	..	..	9	14	4	11	5·8	270	215
Sherborne..	255	214	1	..	..	19	2	19	8·2	222	227
Sturminster	213	181	2	..	3	20	2	5	3·3	194	169
Wareham and Purbeck	406	354	2	..	15	26	2	7	2·2	420	353
Weymouth	958	544	..	..	33	100	..	281	29·3	516	653
Wimborne and Cranborne.	431	368	..	..	7	37	5	14	4·4	465	404
	4,805	3,746	12	..	162	324	68	493	11·7	4,293	4,008
DURHAM.											
Auckland	3,343	2,193	23	..	214	502	109	302	12·3	2,773	2,016
Chester-le-Street ..	2,283	1,726	14	..	13	340	41	149	8·3	2,119	1,813
Darlington	1,539	845	7	..	36	188	82	381	30·1	722	1,137
Durham	2,381	1,713	25	..	98	322	89	134	9·4	1,825	1,729
Easington	1,792	1,496	8	..	21	211	16	40	3·1	1,600	1,663
Gateshead..	6,123	3,039	25	..	397	848	100	1,714	29·6	3,202	2,535
Hartlepool	2,934	2,318	17	..	46	384	60	79	4·7	2,377	2,440
Houghton-le-Spring ..	1,503	1,147	30	..	8	220	20	78	6·5	1,242	1,333
Lanchester	2,919	2,023	22	..	126	379	134	235	12·6	2,156	2,028
Sedgefield	766	649	3	..	10	87	4	13	2·2	714	600
South Shields	5,800	3,649	25	..	32	829	225	1,040	21·8	3,904	4,219
Stockton	2,124	1,639	5	..	63	281	10	126	6·4	1,797	1,927
Sunderland	6,501	4,706	34	..	35	924	173	629	12·3	5,255	4,923
Teesdale	539	398	..	..	17	72	7	45	9·6	641	629
Weardale	434	365	..	..	18	37	4	10	3·2	434	353
	40,981	27,936	238	..	1,134	5,624	1,074	4,975	14·8	30,761	29,345

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ESSEX.											
Billericay	458	351	4	..	20	46	2	35	8·1	438	424
Braintree	617	432	1	..	13	44	49	78	20·6	423	378
Chelmsford	841	713	..	..	38	59	5	26	3·7	828	773
Colchester	986	445	3	..	32	101	2	403	41·1	417	596
Dunmow	359	302	..	..	9	26	4	18	6·1	302	145
Epping	673	532	7	..	22	66	8	38	6·8	493	512
Halstead	407	323	..	..	35	28	5	16	5·2	377	201
Lexden and Winstree ..	562	475	1	..	27	30	3	26	5·2	467	373
Maldon	630	480	1	..	56	51	6	36	6·7	476	386
Ongar	244	205	..	..	..	26	..	13	5·3	212	175
Orsett	1,003	521	5	..	182	99	40	156	19·5	558	524
Rochford	1,279	792	3	..	106	136	25	217	18·9	689	926
Romford	2,606	1,703	18	..	41	294	58	492	21·1	1,784	2,168
Saffron Walden	362	318	3	..	7	24	3	7	2·8	379	336
Tendring	1,206	831	4	..	63	120	40	148	15·6	934	854
West Ham	17,876	10,000	104	..	247	2,223	611	4,691	29·7	11,477	11,403
	30,109	18,423	154	..	898	3,373	861	6,400	24·1	20,254	20,264
GLOUCESTER.											
Barton Regis	398	282	3	..	3	42	27	41	17·1	413	300
Bristol	9,352	4,935	74	..	161	1,170	366	2,646	32·2	5,073	5,930
Cheltenham	1,254	613	8	..	200	144	10	279	23·0	640	720
Chipping Sodbury ..	461	325	1	..	2	47	9	77	18·7	391	317
Cirencester	452	372	4	..	18	41	6	8	3·1	532	387
Dursley	274	163	4	..	32	21	5	49	19·7	265	173
Gloucester	1,671	642	2	..	234	214	49	530	34·6	771	632
Newent	240	193	..	..	11	15	7	14	8·8	251	195
Northleach	209	170	3	..	11	19	..	6	2·9	179	161
Stow-on-the-Wold ..	191	147	1	..	20	16	1	6	3·7	227	154
Stroud	915	411	2	..	166	83	29	224	27·7	807	271
Tetbury	137	104	..	..	18	11	..	4	2·9	162	123
Tewkesbury	323	81	..	..	66	35	13	128	43·7	81	52
Thornbury	405	328	2	..	32	23	7	13	4·9	338	358
Westbury-on-Severn ..	680	316	2	..	184	59	36	83	17·5	542	284
Wheatenhurst	126	58	..	..	..	2	..	66	52·4	58	53
Winchcomb	237	163	..	..	46	10	1	17	7·6	197	168
	17,325	9,303	106	..	1,204	1,955	566	4,191	27·5	10,927	10,278
HEREFORD.											
Bromyard	269	208	..	..	2	23	15	18	12·3	232	239
Dore	192	151	..	..	9	14	9	9	9·4	151	101
Hereford	833	650	2	..	17	85	24	55	9·5	750	647
Kington	250	202	2	..	8	23	7	8	6·0	193	262
Ledbury	352	299	..	..	5	25	3	20	6·5	267	371
Leominster	348	293	..	..	5	37	6	7	3·7	310	228
Ross..	411	330	1	..	19	37	4	20	5·8	323	344
Weobley	150	133	6	..	1	3	..	7	4·7	135	147
	2,805	2,266	11	..	66	250	68	144	7·6	2,361	2,339

PP A, No. 1A.

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—	Returns, 1899.									Total number of Certificates of successful Primary Vaccination at ALL AGES received during each of the calendar years 1899 and 1900.	
	Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Number in respect of whom Certificates of conscientious objection have been received.	Died unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of births.	1899.	1900.
HERTS.											
Albans, St.	786	364	..	..	116	76	3	227	29·3	185	536
Barnet	1,344	948	15	..	49	111	63	158	16·4	1,052	984
Berkhampstead.. ..	363	269	..	..	37	30	7	20	7·4	367	278
Bishop Stortford ..	516	413	..	..	24	49	9	21	5·8	353	430
Buntingford	108	97	3	..	1	5	..	2	1·9	119	108
Hatfield	206	182	2	..	3	12	..	7	3·4	196	185
Hemel Hempstead ..	439	235	2	..	33	21	..	118	26·9	259	300
Hertford	393	327	1	..	15	38	1	11	3·1	404	333
Hitchin	691	594	2	..	23	42	1	29	4·3	647	603
Royston	347	291	..	..	8	29	9	10	5·5	291	349
Ware	528	452	5	..	8	35	8	20	5·3	403	464
Watford	1,257	922	8	..	49	117	41	120	12·8	1,051	908
Welwyn	69	59	..	..	1	4	..	5	7·2	59	29
	7,047	5,153	38	..	367	599	142	748	12·6	5,386	5,507
HUNTINGDON.											
Huntingdon	509	409	2	..	29	43	5	21	5·1	459	388
Ives, St.	371	315	3	..	12	30	1	10	3·0	328	316
Neots, St.	337	275	..	..	13	34	..	15	4·5	439	280
	1,217	999	5	..	54	107	6	46	4·3	1,226	984
KENT (EXTRA METROPOLITAN).											
Ashford, East	328	276	1	..	18	22	2	9	3·4	321	283
Ashford, West	486	374	..	..	37	47	7	21	5·8	280	195
Blean	551	425	2	..	23	63	5	33	6·9	490	548
Bridge	275	225	2	..	2	20	6	11	6·2	190	197
Bromley	1,993	1,501	17	..	55	209	11	200	10·6	1,707	1,755
Canterbury	488	384	8	..	7	48	..	41	8·4	391	392
Cranbrook	286	222	..	..	7	31	2	24	9·1	210	226
Dartford	2,672	2,130	23	..	100	305	25	89	4·3	2,347	2,602
Dover	1,314	1,057	10	..	22	146	8	71	6·0	1,212	1,145
Eastry	757	654	2	..	17	63	1	20	2·8	765	642
Elham	1,226	959	9	..	42	122	19	75	7·7	1,060	1,046
Faversham	731	621	8	..	16	70	3	13	2·2	651	653
Gravesend and Milton	711	354	3	..	4	97	..	253	35·6	375	345
Hollingbourn	292	238	1	..	2	17	7	27	11·6	245	259
Hoo	107	86	3	..	..	10	4	4	7·5	109	105
Maidstone..	1,234	791	5	..	61	99	81	197	22·5	1,102	817
Malling	766	627	12	..	11	88	6	22	3·7	664	611
Medway	2,550	2,028	12	..	40	284	55	131	7·3	2,412	2,207
Milton	847	692	10	..	29	87	2	27	3·4	866	738
Romney Marsh	152	133	..	..	1	15	1	2	2·0	140	132
Sevenoaks..	707	536	10	..	12	68	20	61	11·5	537	592
Sheppey	527	391	3	..	8	64	17	44	11·6	364	516
Strood	1,282	1,016	13	..	39	155	9	50	4·6	1,161	1,240
Tenterden..	201	156	4	..	10	14	12	5	8·5	154	217
Thanet, Isle of	1,528	1,076	7	..	143	152	20	130	9·8	1,217	1,198
Tonbridge..	1,557	930	8	..	292	133	46	148	12·5	1,211	1,005
	23,568	17,882	173	..	998	2,438	369	1,708	8·8	20,181	19,735

—	Returns, 1899. Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Number in respect of whom Certificates of conscientious objection have been received.	Died unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of births.	Total number of Certificates of successful Primary Vaccination at ALL AGES received during each of the calendar years 1899 and 1900. 1899.	1900.
ANCASTER.											
-under-Lyne ..	4,799	2,751	13	..	393	835	66	741	16·8	5,157	3,331
w-in-Furness ..	1,706	1,453	15	..	15	184	13	26	2·3	1,495	1,653
-upon-Irwell ..	2,902	1,891	18	..	42	382	174	395	19·6	2,014	2,128
urn	6,312	4,805	16	..	199	865	97	330	6·8	5,503	5,764
.. .. ..	7,454	6,347	46	..	47	826	19	169	2·5	7,325	7,212
y	5,608	2,305	28	..	785	879	139	1,472	28·7	2,664	2,995
.. .. ..	3,646	2,031	18	..	535	491	25	546	15·7	3,621	2,253
y	1,808	1,381	10	..	4	252	21	140	8·9	1,531	1,532
on	9,873	5,953	64	..	63	1,479	131	2,183	23·4	6,165	7,286
roe	531	409	1	..	16	47	27	31	10·9	488	401
The	2,490	1,607	14	..	75	290	158	346	20·2	1,597	1,610
ng	294	267	..	..	1	18	..	8	2·7	286	236
gden	2,804	1,895	12	..	321	322	50	204	9·1	2,052	2,285
ster	1,764	1,347	3	..	11	243	17	143	9·1	1,453	1,525
.. .. ..	2,814	2,243	24	..	28	362	18	139	5·6	2,656	2,668
ool	5,100	3,843	19	..	6	845	20	367	7·6	3,622	4,394
dale	168	132	1	..	..	17	..	18	10·7	137	161
ester	4,773	3,019	26	..	8	806	154	760	19·1	2,972	3,448
n	5,789	2,689	26	..	1,150	852	2	1,070	18·5	3,103	3,116
irk	2,618	2,153	49	..	32	288	26	70	3·7	2,437	2,257
t	5,300	4,358	41	..	28	598	29	246	5·2	5,080	4,799
n	4,451	2,941	28	..	30	819	55	578	14·2	3,603	3,769
ich	5,915	4,339	59	..	47	715	85	670	12·8	4,804	5,086
ale	2,841	1,398	12	..	442	402	5	582	20·7	442	1,738
l	7,649	5,166	39	..	76	1,188	124	1,056	15·4	6,272	5,931
rden	986	700	11	..	119	91	7	58	6·6	965	731
h Park	4,194	2,826	39	..	5	611	157	556	17·0	2,955	3,197
ton	1,062	936	8	..	3	106	3	6	0·8	1,029	1,067
gton	3,430	2,526	31	..	23	522	54	274	9·6	2,387	2,585
Derby	16,858	12,868	118	..	21	2,258	215	1,378	9·4	12,833	14,695
.. .. ..	6,986	5,427	31	..	75	977	75	401	6·8	6,698	5,887
	132,925	92,006	820	..	4,600	18,570	1,966	14,963	12·7	103,346	105,740
EICESTER.											
-de-la-Zouch ..	1,425	670	2	..	259	152	21	321	24·0	1,035	637
y-on-Soar ..	730	111	..	..	263	115	6	235	33·0	141	146
on	120	74	2	..	17	10	..	17	14·2	74	87
.. .. ..	722	195	1	..	235	94	13	184	27·3	264	230
ey	772	133	..	..	174	91	1	373	48·4	44	89
er	6,274	219	4	..	167	1,168	..	4,716	75·2	219	466
borough	989	223	..	..	432	116	95	123	22·0	300	187
worth	231	157	..	..	20	17	1	36	16·0	91	474
Bosworth ..	530	197	..	..	208	53	11	61	13·6	197	119
Harborough ..	450	123	1	..	52	34	4	236	53·3	123	160
Mowbray ..	609	341	1	..	139	83	4	41	7·4	706	448
	12,852	2,443	11	..	1,966	1,933	156	6,343	50·6	3,194	3,043
LINCOLN.											
.. .. ..	1,091	720	8	..	157	126	16	64	7·3	959	1,127
.. .. ..	455	284	..	..	9	54	..	108	23·7	334	299
.. .. ..	407	266	7	..	84	35	4	11	3·7	303	326
rough	1,037	455	2	..	251	133	40	156	18·9	598	425
d Brigg	1,360	766	6	..	296	167	23	102	9·2	969	782
am	832	614	4	..	54	74	10	76	10·3	610	613

.PP. A, No. 1A.

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'accination
fficers'
leturns, 1899.

—	Returns, 1899.									Total number of Certificates of successful Primary Vaccination at ALL AGES received during each of the calendar years 1899 and 1900.	
	Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Number in respect of whom Certificates of conscientious objection have been received.	Died unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of births.	1899.	1900.
LINCOLN—*cont.*											
Grimsby	2,484	1,428	40	..	140	395	95	386	19·4	2,245	1,940
Holbeach	477	312	..	..	113	42	1	9	2·1	563	357
Horncastle	467	350	2	..	7	35	21	43	13·7	397	334
Lincoln	1,912	1,355	7	..	147	272	25	106	6·9	1,562	1,389
Louth	656	529	3	..	39	60	14	11	3·8	538	574
Sleaford	618	457	6	..	36	48	11	60	11·5	617	472
Spalding	564	356	2	..	118	55	11	22	5·9	560	417
Spilsby	595	508	7	..	4	63	4	9	2·2	660	527
Stamford	384	294	2	..	22	44	4	18	5·7	310	312
	13,339	8,703	96	..	1,477	1,603	279	1,181	10·9	11,225	9,924
MIDDLESEX (Extra Metropolitan).											
Brentford	4,664	3,310	42	..	18	566	41	687	15·6	3,658	3,813
Edmonton	9,327	5,535	59	..	162	1,045	176	2,350	27·1	5,788	6,194
Hendon	1,321	911	9	..	45	155	9	192	15·2	1,086	992
Staines	923	741	2	..	8	81	6	85	9·9	792	804
Uxbridge	1,013	819	3	..	21	109	7	54	6·0	934	843
Willesden	3,375	2,215	34	..	69	407	21	629	19·3	2,409	2,562
	20,623	13,531	149	..	323	2,363	260	3,997	20·6	14,667	15,208
MONMOUTH.											
Abergavenny	707	478	3	..	62	90	9	65	10·5	642	513
Bedwellty	2,844	1,886	2	..	22	459	105	370	16·7	1,912	2,438
Chepstow	531	354	..	..	50	58	7	62	13·0	539	331
Monmouth	770	460	1	..	120	67	11	111	15·8	460	574
Newport	3,688	2,712	23	..	129	477	88	259	9·4	3,085	2,858
Pontypool	1,382	1,024	..	..	47	163	42	106	10·7	1,144	853
	9,922	6,914	29	..	430	1,314	262	973	12·4	7,782	7,567
NORFOLK.											
Aylsham	495	426	..	..	19	41	2	7	1·8	445	307
Blofield	285	240	..	..	19	22	..	4	1·4	257	235
Depwade	503	406	3	..	38	35	6	15	4·2	429	433
Docking	451	392	1	..	21	30	..	7	1·6	399	342
Downham	448	377	2	..	3	54	..	12	2·7	406	401
Erpingham	580	438	1	..	49	50	13	29	7·2	493	422
Faith, St.	331	250	..	..	37	25	6	13	5·7	250	283
Flegg, East and West ..	294	241	7	..	5	28	4	9	4·4	283	281
Forehoe	290	211	3	..	15	23	..	38	13·1	211	109
Freebridge Lynn ..	300	241	4	..	25	21	..	9	3·0	260	207
Guiltcross	263	205	1	..	15	28	..	14	5·3	175	222
Henstead	262	209	..	..	18	25	..	10	3·8	296	233
King's Lynn	568	73	..	..	70	85	11	329	59·9	76	76
Loddon and Clavering	296	253	1	..	6	27	1	8	3·0	266	251
Mitford and Launditch	598	443	2	..	25	65	15	48	10·5	369	462
Norwich	3,203	1,590	15	..	1,044	511	5	116	3·7	1,484	1,536
Smallburgh	478	387	1	..	28	47	4	11	3·1	377	374
Swaffham	265	217	..	..	6	23	6	13	7·2	244	206
Thetford	447	365	..	..	29	28	10	15	5·6	343	269
Walsingham	499	381	1	..	37	56	6	18	4·8	403	386
Wayland	234	186	..	..	13	22	5	8	5·6	171	167
Yarmouth, Great ..	1,463	1,120	10	..	55	204	14	60	5·1	1,465	1,578
	12,643	8,069	52	..	1,577	1,453	108	793	7·1	9,102	8,783

APP. A, No. L

Digest of Vaccination Officers' Returns, 1899

	Returns, 1899.									Total number of Certificates of successful Primary Vaccination at ALL AGES received during each of the calendar years 1899 and 1900.	
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THAMPTON.											
y	284	161	1	..	25	29	14	54	23·9	161	85
'th	319	135	1	..	44	18	2	119	37·9	114	135
y	412	227	1	..	46	35	10	93	25·0	370	285
stone	314	182	6	..	77	27	2	20	7·0	215	127
ıg	1,537	194	1	..	145	242	24	931	62·1	194	348
npton	2,493	348	5	..	318	309	17	1,496	60·7	447	408
.. .. ..	215	180	1	..	6	16	1	11	5·6	180	126
rough	1,497	1,135	..	..	36	160	..	166	11·1	1,151	1,204
ury	317	198	..	..	70	33	..	16	5·0	338	223
on	404	161	..	..	172	34	5	32	9·2	190	179
er	205	156	..	..	59	29	7	44	17·3	303	127
borough ..	1,718	207	3	..	262	198	22	1,026	61·0	211	199
	9,805	3,284	19	..	1,260	1,130	104	4,008	41·9	3,874	3,446
UMBERLAND.											
.. .. ..	645	454	5	..	8	63	36	79	17·8	413	447
.. .. ..	119	111	..	..	1	6	1	..	0·8	116	133
am	151	126	..	..	9	7	1	8	6·0	146	128
-upon-Tweed	522	447	..	..	..	58	8	9	3·3	524	450
'ard	815	469	4	..	32	64	20	226	30·2	469	758
.. .. ..	187	165	..	..	1	15	3	3	3·2	171	156
stle	234	137	..	..	70	21	5	1	2·6	89	47
.. .. ..	925	638	2	..	74	109	33	69	11·0	649	603
.. .. ..	1,856	700	4	..	24	359	13	756	41·4	680	887
le-on-Tyne ..	7,780	5,790	36	..	101	1,075	56	722	10·0	5,305	6,285
y	135	124	1	..	..	9	1	..	0·7	126	124
uth	5,751	3,965	41	..	148	827	255	515	13·4	4,310	4,210
	19,120	13,126	93	..	468	2,613	432	2,388	14·7	12,998	14,228
TINGHAM.											
.. .. ..	5,213	2,770	44	..	489	666	159	1,085	23·9	3,358	2,977
ı	335	258	2	..	32	27	5	11	4·8	295	281
ford	670	535	8	..	30	57	6	34	6·0	565	532
d	2,964	1,410	8	..	72	512	67	895	32·5	2,019	2,083
.. .. ..	761	439	3	..	15	91	4	209	29·8	440	462
am	6,864	3,417	34	..	614	1,122	308	1,369	24·4	4,060	4,133
ll..	474	341	5	..	21	39	5	63	14·3	280	334
.. .. ..	1,268	930	11	..	27	176	8	116	9·8	901	997
	18,549	10,100	115	..	1,300	2,690	562	3,782	23·4	11,918	11,799
XFORD.											
.. .. ..	753	382	1	..	219	59	3	89	12·2	1,448	774
.. .. ..	279	214	..	..	11	26	8	20	10·0	222	249
Norton ..	391	259	1	..	46	31	7	47	13·8	355	440
on	818	688	2	..	29	74	4	21	3·1	742	800
.. .. ..	617	488	..	..	33	58	5	33	6·2	458	524
.. .. ..	560	460	2	..	24	52	2	20	3·9	570	506
.. .. ..	302	234	3	..	30	27	..	8	2·6	264	236
.. .. ..	487	391	6	..	33	37	6	14	4·1	426	353
k	337	275	3	..	32	11	1	15	4·7	321	249
	4,544	3,391	18	..	457	375	36	267	6·7	4,806	4,131

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RUTLAND.											
Oakham	268	235	3	..	11	16	..	3	1·1	276	254
Uppingham	221	186	3	..	16	13	..	3	1·4	234	173
	489	421	6	..	27	29	..	6	1·2	510	427
SALOP.											
Atcham	1,261	1,049	6	..	13	121	17	55	5·7	1,490	1,167
Bridgnorth	400	330	2	..	15	34	2	17	4·8	368	336
Church Stretton ..	110	104	..	..	..	5	..	1	0·9	95	116
Cleobury Mortimer ..	219	192	..	..	5	13	1	8	4·1	194	142
Clun	226	183	..	..	5	15	1	22	10·2	189	118
Drayton	332	285	3	..	4	30	5	5	3·0	276	309
Ellesmere	407	352	..	..	1	43	..	11	2·7	358	301
Ludlow	463	381	..	..	12	51	8	11	4·1	471	438
Madeley	686	577	..	..	8	67	13	21	5·0	629	602
Newport	324	268	3	..	..	34	3	16	5·9	320	314
Oswestry	734	640	5	..	6	66	6	11	2·3	716	656
Shifnal	294	241	1	..	1	29	6	16	7·5	241	236
Wellington	689	446	..	..	6	79	..	158	22·9	751	618
Wem	266	224	..	..	8	21	7	6	4·9	244	256
Whitchurch	311	236	3	..	6	20	15	31	14·8	236	252
	6,722	5,508	23	..	90	628	84	389	7·0	6,578	5,861
SOMERSET.											
Axbridge	977	499	2	..	159	100	31	186	22·2	762	536
Bath	1,710	1,047	10	..	91	195	155	212	21·5	1,113	1,302
Bridgwater	913	512	10	..	93	72	36	190	24·8	844	482
Chard	628	524	1	..	10	62	10	21	4·9	593	534
Clutton	732	522	1	..	72	72	13	52	8·9	629	523
Dulverton	112	100	..	..	6	6	..	..	0·0	100	81
Frome	541	407	..	..	62	43	5	24	5·4	412	583
Keynsham	1,111	512	..	..	45	142	21	361	34·4	538	350
Langport	316	248	..	..	27	26	5	10	4·7	426	296
Long Ashton	534	344	1	..	29	53	17	90	20·0	397	368
Shepton Mallet	415	259	2	..	64	45	5	40	10·8	261	300
Taunton	1,038	782	13	..	83	122	9	29	3·7	841	1,194
Wellington	450	357	3	..	40	35	1	14	3·3	421	351
Wells	548	357	4	..	37	48	26	76	18·6	311	295
Williton	357	291	..	..	15	38	8	5	3·6	334	285
Wincanton	323	243	..	..	17	30	6	17	10·2	230	262
Yeovil	683	518	7	..	75	47	20	16	5·3	578	480
	11,388	7,552	54	..	925	1,136	368	1,353	15·1	8,790	8,222
SOUTHAMPTON.											
Alresford	156	140	1	..	..	9	3	3	3·8	140	116
Alton	370	305	..	..	4	40	4	17	5·7	384	392
Alverstoke	780	648	10	..	1	92	1	28	3·7	648	734
Andover	421	291	2	..	53	45	10	20	7·1	375	320
Basingstoke	503	361	3	..	68	41	17	13	6·0	418	469
Catherington	41	37	..	..	1	2	..	1	2·4	50	65
Christchurch	1,334	826	5	..	16	162	9	316	24·4	742	943
Droxford	269	237	..	..	2	20	1	9	3·7	236	232
Fareham	486	412	2	..	2	45	3	22	5·1	455	460
Fordingbridge	176	144	1	..	15	11	..	5	2·8	138	115

	Returns, 1899.									Total number of Certificates of successful Primary Vaccination at ALL AGES received during each of the calendar years 1899 and 1900.	
	Births	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Number in respect of whom Certificates of conscientious objection have been received.	Died unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of births.	1899.	1900.
.MPTON—*cont.*											
Wintney ..	678	562	3	..	7	62	7	37	6·5	672	557
.. .. ..	276	235	1	..	5	21	4	10	5·1	286	261
.. .. ..	99	83	..	..	1	4	1	10	11·1	91	95
'e	221	196	1	..	8	15	..	1	0·5	201	199
on	314	254	4	1	4	14	1	36	11·8	249	254
est	331	280	..	..	2	24	3	22	7·6	310	395
d	274	220	..	..	10	25	4	15	6·9	222	282
ith	4,981	4,171	60	..	23	645	18	64	1·6	4,557	4,502
l	150	129	1	..	1	11	..	8	5·3	136	150
.. .. ..	267	224	..	..	18	19	1	5	2·2	183	303
pton	1,802	1,391	12	..	39	240	19	101	6·7	1,441	1,567
onehan ..	2,247	1,632	14	1	53	219	63	265	14·6	1,711	1,850
lge	135	112	..	..	8	10	..	5	3·7	133	130
rch	169	132	..	..	3	17	9	8	10·1	132	79
le of	1,787	1,376	7	..	124	146	34	100	7·5	1,593	1,635
er, New ..	743	595	2	..	32	66	19	29	6·5	654	606
	19,010	14,993	129	2	500	2,005	231	1,150	7·3	16,157	16,711
AFFORD.											
pon-Trent ..	2,731	1,526	6	..	70	314	..	815	29·8	1,652	1,543
.. .. ..	1,704	1,391	4	..	27	188	11	83	5·5	2,243	1,349
.. .. ..	727	605	2	..	9	67	8	36	6·1	725	620
.. .. ..	1,242	1,005	1	..	51	144	17	24	3·3	1,166	1,194
.. .. ..	1,279	1,053	15	..	15	138	17	41	4·5	1,078	1,092
e-under-Lyme	1,248	1,067	13	..	3	141	8	16	1·9	953	1,160
.. .. ..	447	360	3	..	13	45	2	24	5·8	497	425
.. .. ..	831	676	1	..	36	68	13	34	5·7	800	662
on-Trent ..	5,455	3,528	31	..	21	964	225	686	16·7	3,262	4,155
.. .. ..	463	381	1	..	4	48	7	22	6·3	291	642
h	735	505	2	..	15	68	14	131	19·7	491	444
.. .. ..	400	346	..	..	5	29	2	18	5·0	371	243
.. .. ..	4,060	2,415	38	..	47	698	87	784	21·4	3,699	2,540
mwich ..	5,572	2,846	38	..	97	793	183	1,615	32·3	4,431	2,589
on and Burslem	3,625	2,734	16	..	11	489	33	342	10·3	3,182	2,812
mpton ..	5,384	3,113	53	..	233	733	122	1,130	23·3	3,903	2,981
	35,912	23,551	227	..	657	4,927	749	5,801	18·2	28,744	24,451
FFOLK.											
.. .. ..	666	509	3	..	6	53	2	3	0·8	663	624
and Claydon	344	266	1	..	20	36	6	15	6·1	267	285
Edmunds ..	418	284	4	..	24	41	35	30	15·6	267	285
.. .. ..	389	354	..	..	4	22	2	7	2·3	386	310
re	370	324	2	..	7	22	5	10	4·1	376	239
.. .. ..	287	246	1	..	7	23	..	10	3·5	304	274
.. .. ..	1,780	777	..	..	258	288	33	424	25·7	639	1,016
ll	209	181	..	..	1	18	3	6	4·3	181	117
ndLothingland	1,225	930	1	..	26	102	19	147	13·6	1,019	1,050
te	550	457	1	..	17	45	9	21	5·5	500	432
.. .. ..	444	381	2	..	12	42	3	4	1·6	408	274
.. .. ..	309	274	1	..	..	28	2	4	1·9	329	308
.. .. ..	530	449	6	..	18	41	3	13	3·0	449	339
.. .. ..	673	568	1	..	21	57	7	19	3·9	609	471
.. .. ..	360	311	3	..	6	30	3	7	2·8	311	312
.. .. ..	383	331	3	..	11	30	4	4	2·1	353	311
ge	590	457	3	..	11	53	11	55	11·2	498	497
	9,527	7,189	32	..	449	931	147	779	9·7	7,559	7.153

'P. A. No. 1A.

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turns, 1899.

	RETURNS, 1899.									Total number of Certificates of successful Primary Vaccination at ALL AGES received during each of the calendar years 1899 and 1900.	
	Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Number in respect of whom Certificates of conscientious objection have been received.	Died unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of births.	1899.	1900.
SURREY (EXTRA METROPOLITAN.											
Chertsey	938	716	4	..	17	85	5	111	12·4	825	796
Croydon	4,615	2,186	20	..	74	518	192	1,625	39·4	2,463	2,295
Dorking	330	232	..	..	37	31	10	20	9·1	320	326
Epsom	1,364	980	4	..	41	126	41	172	15·6	929	1,011
Farnham	1.595	1,263	10	..	28	153	10	131	8·8	1,593	1,320
Godstone	618	438	..	..	9	61	23	87	17·8	524	438
Guildford	1,456	1,025	9	..	105	138	89	90	12·3	1,333	1,117
Hambledon	480	395	5	..	20	46	3	20	4·7	435	434
Kingston	3,429	2,246	19	..	91	355	94	624	20·9	2,003	3,048
Reigate	985	710	2	..	84	95	14	80	9·5	871	782
Richmond	1,159	967	8	..	13	117	1	44	3·9	1,005	1,009
	16,969	11,158	81	..	519	1,725	482	3,004	20·5	12,301	12,576
SUSSEX.											
Battle	553	440	..	..	22	34	11	46	10·3	588	639
Brighton	2,578	1,610	14	..	51	355	33	515	21·3	1,839	1,793
Chichester	202	231	5	..	6	34	2	14	5·5	231	169
Cuckfield	527	435	1	..	23	42	7	19	4·9	520	534
Eastbourne	1,141	298	3	..	117	121	31	571	52·8	299	392
East Grinstead	461	274	1	..	31	28	34	93	27·5	283	238
East Preston	844	625	..	..	39	101	32	47	9·4	673	715
Hailsham	398	235	1	..	91	27	7	37	11·1	248	287
Hastings	1,310	936	14	..	120	125	9	106	8·8	1,171	998
Horsham	651	516	1	..	20	63	16	35	7·8	534	490
Lewes	492	173	1	..	150	35	20	113	27·0	188	168
Midhurst	326	295	1	..	3	21	1	5	1·8	274	264
Newhaven	309	161	..	..	49	40	3	56	19·1	161	203
Petworth	194	167	2	..	6	16	1	2	1·5	191	164
Rye	271	202	4	..	33	23	..	9	3·3	252	231
Steyning	1,823	1,335	18	..	49	191	26	204	12·6	1,270	1,498
Thakeham	185	161	1	..	4	14	..	5	2·7	149	183
Ticehurst	354	262	3	..	45	19	6	19	7·1	321	285
Uckfield	530	321	..	..	112	36	11	50	11·5	405	341
Westbourne	180	146	..	..	2	17	9	6	8·3	159	133
Westhampnett	448	382	2	..	3	41	3	17	4·5	457	391
	13,867	9,205	72	..	976	1,383	262	1,969	16·1	10,213	10,116
WARWICK.											
Alcester	537	458	1	..	32	34	4	8	2·2	549	508
Aston	10,435	7,203	106	..	41	1,540	116	1,426	14·8	7,990	8,282
Atherstone	588	300	3	..	12	60	25	188	36·2	303	322
Birmingham	8,598	5,638	60	..	28	1,439	47	1,386	16·7	6,111	6,107
Coventry	1,888	963	5	..	110	235	..	575	30·5	963	903
Foleshill	896	657	..	..	69	100	3	67	7·8	980	545
Meriden	239	147	1	..	6	26	1	58	24·7	88	62
Nuneaton	984	318	..	..	77	147	..	442	44·9	318	227
Rugby	864	95	..	..	14	83	1	671	77·8	95	241
Solihull	1,201	898	11	..	15	125	5	147	12·7	937	1,104
Southam	276	204	4	..	31	18	8	11	6·9	306	215
Stratford-on-Avon	488	356	..	..	28	46	8	50	11·9	262	468
Warwick	1,188	959	7	..	54	108	12	48	5·1	1,220	1,003
	28,182	18,196	198	..	520	3,961	230	5,077	18·8	20,122	19,987

APP. A, No. 1A

Digest of Vaccination Officers' Returns, 1899.

—	Returns, 1899.									Total number of Certificates of successful Primary Vaccination at ALL AGES received during each of the calendar years 1899 and 1900.	
	Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Number in respect of whom Certificates of conscientious objection have been received.	Died unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of births.	1899.	1900.
TMORLAND.											
ard	307	216	..	..	35	31	5	20	8·1	236	200
.. .. ..	1,016	897	6	..	13	80	8	12	2·0	1,055	922
'ard	213	171	1	..	7	24	6	4	4·7	189	196
	1,536	1,284	7	..	55	135	19	36	3·6	1,480	1,318
WILTS.											
ıry..	175	139	1	..	14	11	1	9	5·7	140	134
rd-on-Avon ..	234	100	..	..	12	18	..	104	44·4	134	112
.. .. ..	187	100	..	..	12	19	11	45	29·9	100	111
nham	606	351	2	..	55	43	42	113	25·6	295	321
de and Wootton tt.	308	159	2	..	69	32	20	26	14·9	384	216
.. .. ..	481	259	6	..	95	47	16	58	15·4	263	234
sbury	343	230	1	..	18	22	1	71	21·0	228	227
rough	201	169	5	..	6	16	1	4	2·5	203	181
.. .. ..	137	118	..	..	7	4	4	4	5·8	88	104
.. .. ..	287	230	2	..	26	19	2	8	3·5	295	243
ry	654	420	..	..	131	65	16	22	5·8	483	452
n and High- ı.	1,750	805	5	..	483	172	27	258	16·3	835	833
.. .. ..	190	145	2	..	3	14	2	24	13·7	139	147
idge and Melk-	400	75	..	..	15	41	18	251	67·3	95	109
ıster	267	220	..	..	16	26	..	5	1·9	270	232
ry and Whor- down.	272	161	1	..	8	19	2	81	30·5	215	227
.. .. ..	232	172	2	..	35	16	2	5	3·0	199	192
	6,724	3,853	29	..	1,005	584	165	1,088	18·6	4,366	4,075
ORCESTER.											
rove	947	764	9	..	19	100	20	35	5·8	820	729
ich	500	436	2	..	3	25	3	31	6·8	471	431
.. .. ..	5,793	4,377	51	..	57	755	134	419	9·5	4,554	4,405
n	508	357	2	..	98	31	3	17	3·9	424	356
minster	992	823	5	..	24	111	8	21	2·9	918	884
Norton	5,236	3,355	50	..	52	564	41	1,174	23·2	3,581	4,170
.. .. ..	445	328	3	..	5	44	14	51	14·6	295	275
e	314	262	1	..	17	22	2	10	3·8	295	309
n-on-Stour ..	391	280	7	..	48	35	2	19	5·4	280	303
idge	3,199	2,683	30	..	29	358	31	68	3·1	2,716	2,661
y	151	129	2	..	..	16	2	2	2·6	175	150
on-Severn ..	478	401	1	..	14	39	11	12	4·8	436	431
er	1,261	843	8	..	21	176	86	127	16·9	843	839
	20,215	15,038	171	..	387	2,276	357	1,986	11·6	15,808	15,943
EAST RIDING.											
y	664	541	4	..	14	64	2	39	6·2	633	540
ton	533	416	6	..	19	50	..	42	7·9	323	240
.. .. ..	447	380	5	..	7	36	6	13	4·3	441	426
ı	345	299	3	..	2	31	2	8	2·9	345	326
n-upon-Hull ..	2,750	1,691	12	1	21	293	53	679	26·6	1,691	1,434
on	180	163	1	..	2	12	..	2	1·1	204	147
gton	362	311	..	..	4	27	4	16	5·5	370	323
es..	5,585	4,409	30	1	43	698	35	369	7·2	8,553	4,920
gh	233	195	..	..	2	28	2	6	3·4	224	195
.. .. ..	2,560	2,054	24	..	28	252	39	163	7·9	2,261	2,011
	13,659	10,459	85	2	142	1,491	143	1,337	10·8	15,045	10,562

APP. A, No. 1A.

Digest of Vaccination Officers' Returns, 1899.

	Returns, 1899.									Total number of Certificates of successful Primary Vaccination at ALL AGES received during each of the calendar years 1899 and 1900.	
	Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Number in respect of whom Certificates of conscientious objection have been received.	Died unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of births.	1899.	1900.
YORK, NORTH RIDING.											
Aysgarth	100	84	..	..	4	8	2	2	4·0	84	69
Bedale	210	177	..	..	7	16	..	10	4·8	177	159
Easingwold	222	171	..	..	1	20	1	29	13·5	206	168
Guisborough	1,361	1,085	10	..	50	145	22	49	5·2	1,045	898
Helmsley	131	105	3	..	4	10	1	8	6·9	117	87
Kirkby Moorside ..	120	107	2	..	2	5	1	3	3·3	107	57
Leyburn	147	129	..	..	1	11	1	5	4·1	148	127
Malton	523	417	3	..	20	54	9	20	5·5	769	524
Middlesbrough	4,862	3,552	32	..	26	723	142	387	10·9	3,655	3,788
Northallerton	302	239	..	..	14	34	2	13	5·0	267	267
Pickering	260	210	1	..	6	25	7	11	6·9	246	253
Reeth	44	42	..	..	1	1	..	..	0·0	57	56
Richmond..	324	274	1	..	2	32	6	9	4·6	290	282
Scarborough	1,293	536	2	..	233	180	40	242	21·8	670	628
Stokesley	274	227	..	..	11	30	2	4	2·2	209	158
Thirsk	312	251	2	..	6	31	6	16	7·1	242	319
Whitby	531	429	8	..	19	54	8	13	4·0	530	420
	11,016	8,095	64	..	407	1,379	250	821	9·7	8,819	8,280
YORK, WEST RIDING.											
Barnsley	4,215	3,388	17	..	35	518	45	212	6·1	3,750	3,369
Bierley, North	3,250	2,144	27	..	66	414	65	543	18·7	2,940	2,771
Bradford	5,508	3,200	11	..	158	770	171	1,198	24·9	3,122	4,282
Bramley	2,361	1,870	31	..	51	283	20	106	5·3	1,933	2,028
Dewsbury	4,436	1,866	15	..	377	634	71	1,473	34·8	1,866	1,170
Doncaster	2,685	1,957	39	..	174	360	43	112	5·8	2,746	2,145
Ecclesall Bierlow ..	5,277	4,178	101	..	51	617	39	291	6·3	4,195	4,375
Goole	862	695	8	..	3	111	4	41	5·2	908	865
Halifax	4,485	1,010	21	..	21	601	8	2,824	63·1	1,415	1,254
Hemsworth	773	587	2	..	10	97	16	61	10·0	675	769
Holbeck	1,136	840	19	..	13	169	26	69	8·4	1,064	934
Huddersfield	4,046	3,269	74	..	150	373	22	158	4·4	3,352	3,549
Hunslet	2,734	2,093	15	..	53	377	71	125	7·2	2,332	2,209
Keighley	1,959	412	7	..	850	204	..	486	24·8	457	462
Knaresborough	957	614	7	..	56	101	66	113	18·7	730	712
Leeds	7,387	5,350	76	..	116	869	208	768	13·2	5,629	5,649
Ouseburn, Great ..	248	222	1	..	9	14	..	2	0·8	240	207
Pateley Bridge	234	183	1	..	3	15	4	28	13·7	214	214
Penistone	449	369	2	..	4	38	23	13	8·0	398	393
Pontefract	2,493	1,877	32	..	51	308	49	176	9·0	1,934	1,989
Ripon	387	326	..	..	7	41	1	12	3·4	466	298
Rotherham	3,983	3,314	28	..	38	439	16	148	4·1	3,676	3,435
Saddleworth	395	263	1	..	68	40	3	20	5·8	420	240
Sedbergh	85	77	..	..	1	6	1	..	1·2	85	76
Selby	481	393	..	..	10	66	1	11	2·5	379	463
Settle	356	274	..	..	28	27	10	17	7·6	306	331
Sheffield	8,052	6,317	118	..	84	1,062	52	419	5·8	7,065	6,853
Skipton	1,158	558	3	..	215	139	23	220	21·0	608	707
Tadcaster	943	821	7	..	12	75	8	20	3·0	819	709
Thorne	424	273	2	..	21	49	9	70	18·6	363	295
Wakefield	3,658	3,036	21	..	60	412	27	102	3·5	3,627	3,101
Wetherby	384	322	..	..	4	44	6	8	3·6	338	361
Wharfedale	1,250	983	11	..	53	133	25	145	12·6	934	1,167
Wortley	1,666	1,306	10	..	18	193	31	108	8·3	1,597	1,294
	78,856	54,387	737	..	2,870	9,599	1,164	10,099	14·3	60,572	58,666

—	Returns, 1899. Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Number in respect of whom Certificates of conscientious objection have been received.	Died unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of births.	Total number of Certificates of successful Primary Vaccination at ALL AGES received during each of the calendar years 1899 and 1900. 1899.	1900.
ANGLESEY.											
Anglesey	344	299	..	..	1	40	2	2	1·2	323	224
Holyhead	565	484	..	..	..	57	8	16	4·2	555	385
	909	783	..	..	1	97	10	18	3·1	878	609
BRECKNOCK.											
Brecknock	415	355	1	..	1	45	4	9	3·1	356	379
Builth	232	186	..	..	3	22	12	9	9·1	198	160
Crickhowell	624	407	..	..	6	74	1	136	22·0	407	666
Hay	225	176	..	..	13	26	5	5	4·4	221	199
	1,496	1,124	1	..	23	167	22	159	12·1	1,182	1,404
CARDIGAN.											
Aberayron	267	226	..	..	..	32	4	5	3·4	219	214
Aberystwith	479	403	..	..	12	45	11	8	4·0	530	381
Cardigan	316	271	..	..	6	28	3	8	3·5	465	380
Lampeter	218	180	..	..	..	34	..	4	1·8	195	164
Tregaron	195	164	1	..	..	27	1	2	1·5	164	164
	1,475	1,244	1	..	18	166	19	27	3·1	1,573	1,303
CARMARTHEN.											
Carmarthen	824	717	2	..	1	92	6	6	1·5	818	702
Llandilo Fawr	674	578	..	..	2	83	7	4	1·6	597	602
Llandovery	232	190	..	..	..	39	1	2	1·3	144	216
Llanelly	1,802	1,503	2	..	9	240	22	26	2·7	1,282	1,814
Newcastle-in-Emlyn ..	452	385	..	..	1	57	2	7	2·0	387	446
	3,984	3,373	4	..	13	511	38	45	2·1	3,228	3,780
CARNARVON.											
Bangor and Beaumaris	1,047	893	3	..	12	118	4	17	2·0	953	992
Carnarvon	1,217	1,033	..	..	1	144	18	21	3·2	1,130	1,467
Conway	813	649	..	..	4	100	5	55	7·4	598	448
Pwllheli	491	381	8	..	1	67	4	30	6·9	328	328
	3,568	2,956	11	..	18	429	31	123	4·3	3,000	3,235
DENBIGH.											
Llanrwst	335	262	..	..	..	47	10	16	7·8	279	250
Ruthin	265	233	..	..	..	28	3	1	1·5	243	228
Wrexham	2,303	1,958	16	..	6	243	26	54	3·5	2,366	2,136
	2,903	2,453	16	..	6	318	39	71	3·8	2,888	2,614

PP. A, No. 1A.

igest of accination fficers' eturns, 1899.

—	Returns, 1899.									Total number of Certificates of successful Primary Vaccination at ALL AGES received during each of the calendar years 1899 and 1900.	
	Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Number in respect of whom Certificates of conscientious objection have been received.	Died unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of births.	1899.	1900.
FLINT.											
Asaph, St.	723	586	1	..	..	105	9	22	4·3	656	600
Hawarden	510	452	2	..	2	35	10	9	3·7	508	493
Holywell	1,189	1,012	..	..	..	112	28	37	5·5	984	837
	2,422	2,050	3	..	2	252	47	68	4·7	2,148	1,930
GLAMORGAN.											
Bridgend and Cowbridge	2,014	1,510	7	..	8	271	46	172	10·8	1,432	983
Cardiff	7,543	5,362	43	..	120	1,038	42	938	13·0	5,585	6,076
Gower	315	247	1	..	2	33	2	30	10·2	284	276
Merthyr Tydfil	4,510	3,239	6	..	29	783	155	298	10·0	3,205	3,701
Neath	2,356	1,883	13	..	18	270	80	92	7·3	1,760	1,785
Pontardawe	893	783	..	..	..	99	5	6	1·2	897	848
Pontypridd	7,070	4,656	12	..	30	1,328	106	938	14·8	4,401	5,799
Swansea	3,668	2,918	5	..	15	436	12	282	8·0	3,001	2,830
	28,369	20,508	87	..	222	4,258	448	2,756	11·3	20,565	22,298
MERIONETH.											
Bala	134	94	..	..	..	22	11	7	13·4	95	91
Corwen	434	378	..	..	4	34	3	15	4·1	381	327
Dolgelly	328	290	..	..	1	30	2	5	2·1	286	268
Festiniog	811	594	1	..	1	119	10	86	11·8	563	662
	1,707	1,356	1	..	6	205	26	113	8·1	1,328	1,348
MONTGOMERY.											
Forden	374	324	1	..	1	40	1	7	2·1	356	310
Llanfyllin	458	408	1	..	2	41	..	6	1·3	422	393
Machynlleth	261	219	..	..	..	31	6	5	4·2	205	200
Newtown and Llanidloes	556	435	3	..	1	54	9	54	11·3	502	438
	1,649	1,386	5	..	4	166	16	72	5·3	1,485	1,341
PEMBROKE.											
Haverfordwest	958	763	1	..	2	117	32	43	7·8	921	835
Narberth	399	367	..	..	..	25	1	6	1·8	372	267
Pembroke	838	700	3	..	4	77	16	38	6·4	704	857
	2,195	1,830	4	..	6	219	49	87	6·2	1,997	1,959
RADNOR.											
Knighton	303	238	..	..	11	21	4	29	10·9	315	277
Rhayader	280	133	..	..	2	17	..	128	45·7	146	147
	583	371	..	..	13	38	4	157	27·6	461	424

No. 2.

Inspection of Public Vaccination.

*LIST (alphabetically arranged) of 285 UNIONS inspected during the Year 1900, with reference to the PROCEEDINGS under the VACCINATION ACTS, 1867 to 1898, and an ACCOUNT of the AWARDS certified by the Board as payable to the respective PUBLIC VACCINATORS out of COUNTY FUNDS.

APP. A, No. 2.

Inspection of Vaccination, and Awards to Public Vaccinators, 1900.

UNION.	No. of Vaccination Districts in the Union.	No. of Public Vaccinators recommended for Award.	Range of Awards in each Union. Minimum.	Range of Awards in each Union. Maximum.	Total Sum awarded in each Union.	Medical Inspector.
			£ s. d.	£ s. d.	£ s. d.	
Aberaeron	2	1	—	—	6 13 0	Dr. Mivart.
Abergavenny	3	3	4 11 0	31 2 0	49 0 0	Do.
Aberystwith	4	4	4 4 0	10 10 0	31 12 0	Do.
Abingdon	6	3	3 7 0	4 13 0	12 10 0	Mr. Royle.
Albans, St.	6	2	1 10 0	3 3 0	5 2 0	Dr. Fletcher.
Alverstoke	1	1	—	—	33 12 0	Mr. Royle.
Andover	5	4	1 14 0	8 0 0	17 7 0	Do.
Anglesey	4	2	9 3 0	9 4 0	18 7 0	Dr. Wheaton.
Asaph, St.	5	4	7 17 0	15 14 0	46 19 0	Do.
Ashbourne	6	4	1 14 0	8 0 0	20 3 0	Dr. Johnstone.
Ashby-de-la-Zouch ..	6	5	5 10 0	13 10 0	40 5 0	„ Darra Mair.
Ashton-under-Lyne..	11	4	2 5 0	13 8 0	30 6 0	„ Wheaton.
Auckland	9	9	5 15 0	28 19 0	143 16 0	„ Manby.
Axminster	11	7	0 18 0	4 18 0	24 11 0	Mr. Royle
Bakewell	8	5	3 14 0	14 0 0	36 7 0	Dr. Johnstone.
Banbury	6	4	1 11 0	11 9 0	18 16 0	Mr. Royle.
Barnet	5	5	3 3 0	14 14 0	47 13 0	Dr. Fletcher.
Barnstaple	11	9	0 15 0	9 3 0	40 9 0	Mr. Royle.
Barrow-on-Soar ..	6	—	—	—	—	Dr. Darra Mair.
Barton-upon-Irwell.	7	6	3 15 0	21 0 0	60 1 0	„ Wheaton.
Bedwellty	7	6	13 14 0	55 15 0	145 16 0	„ Mivart.
Berkhampstead ..	3	3	3 12 0	8 3 0	18 3 0	„ Fletcher.
Bicester	7	5	0 12 0	6 14 0	16 2 0	Mr. Royle
Bideford	6	3	3 15 0	8 17 0	17 8 0	Do.

* This list does not include Oldham Union, and in this respect differs from the corresponding list in the Local Government Board's report, 1900-1901.

P. A, No. 1A.

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;urns, 1899.

—	Returns, 1899. Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Number in respect of whom Certificates of conscientious objection have been received.	Died unvaccinated.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of births.	Total number of Certificates of successful Primary Vaccination at ALL AGES received during each of the calendar years 1899 and 1900. 1899.	1900.
FLINT.											
Asaph, St.	723	586	1	..	..	105	9	22	4·3	656	600
Hawarden	510	452	2	..	2	35	10	9	3·7	508	493
Holywell	1,189	1,012	..	..	..	112	28	37	5·5	984	837
	2,422	2,050	3	..	2	252	47	68	4·7	2,148	1,930
GLAMORGAN.											
Bridgend and Cowbridge	2,014	1,510	7	..	8	271	46	172	10·8	1,432	983
Cardiff	7,543	5,362	43	..	120	1,038	42	938	13·0	5,585	6,076
Gower	315	247	1	..	2	33	2	30	10·2	284	276
Merthyr Tydfil	4,510	3,239	6	..	29	783	155	298	10·0	3,205	3,701
Neath	2,356	1,883	13	..	18	270	80	92	7·3	1,760	1,785
Pontardawe	893	783	..	..	..	99	5	6	1·2	897	848
Pontypridd	7,070	4,656	12	..	30	1,328	106	938	14·8	4,401	5,799
Swansea	3,668	2,918	5	..	15	436	12	282	8·0	3,001	2,830
	28,369	20,538	87	..	222	4,258	448	2,756	11·3	20,565	22,298
MERIONETH.											
Bala	134	94	..	..	..	22	11	7	13·4	95	91
Corwen	434	378	..	..	4	34	3	15	4·1	384	327
Dolgelly	328	290	..	..	1	30	2	5	2·1	286	268
Festiniog	811	594	1	..	1	119	10	86	11·8	563	662
	1,707	1,356	1	..	6	205	26	113	8·1	1,328	1,348
MONTGOMERY.											
Forden	374	324	1	..	1	40	1	7	2·1	356	310
Llanfyllin	458	408	1	..	2	41	..	6	1·3	422	393
Machynlleth	261	219	..	..	..	31	6	5	4·2	205	200
Newtown and Llanidloes	556	435	3	..	1	54	9	54	11·3	502	438
	1,649	1,386	5	..	4	166	16	72	5·3	1,485	1,341
PEMBROKE.											
Haverfordwest	958	763	1	..	2	117	32	43	7·8	921	835
Narberth	399	367	..	..	..	25	1	6	1·8	372	267
Pembroke	838	700	3	..	4	77	16	38	6·4	704	857
	2,195	1,830	4	..	6	219	49	87	6·2	1,997	1,959
RADNOR.											
Knighton	303	238	..	..	11	21	4	29	10·9	315	277
Rhayader	280	133	..	..	2	17	..	128	45·7	146	147
	583	371	..	..	13	38	4	157	27·6	461	424

No. 2.

Inspection of Public Vaccination.

*LIST (alphabetically arranged) of 285 UNIONS inspected during the Year 1900, with reference to the PROCEEDINGS under the VACCINATION ACTS, 1867 to 1898, and an ACCOUNT of the AWARDS certified by the Board as payable to the respective PUBLIC VACCINATORS out of COUNTY FUNDS.

APP. A, No. 2.
Inspection of Vaccination, and Awards to Public Vaccinators, 1900.

UNION.	No. of Vaccination Districts in the Union.	No. of Public Vaccinators recommended for Award.	Range of Awards in each Union. Minimum.	Range of Awards in each Union. Maximum.	Total Sum awarded in each Union.	Medical Inspector.
			£ s. d.	£ s. d.	£ s. d.	
Aberaeron	2	1	—	—	6 13 0	Dr. Mivart.
Abergavenny	3	3	4 11 0	31 2 0	49 6 0	Do.
Aberystwith	4	4	4 4 0	10 10 0	31 12 0	Do.
Abingdon	6	3	3 7 0	4 13 0	12 10 0	Mr. Royle.
Albans, St.	6	2	1 19 0	3 3 0	5 2 0	Dr. Fletcher.
Alverstoke	1	1	—	—	33 12 0	Mr. Royle.
Andover	5	4	1 14 0	8 0 0	17 7 0	Do.
Anglesey	4	2	9 3 0	9 4 0	18 7 0	Dr. Wheaton.
Asaph, St.	5	4	7 17 0	15 14 0	46 19 0	Do.
Ashbourne	6	4	1 14 0	8 0 0	20 3 0	Dr. Johnstone.
Ashby-de-la-Zouch ..	6	5	5 10 0	13 10 0	40 5 0	„ Darra Mair.
Ashton-under-Lyne ..	11	4	2 5 0	13 8 0	30 6 0	„ Wheaton.
Auckland	9	9	5 15 0	28 19 0	143 16 0	„ Manby.
Axminster	11	7	0 18 0	4 18 0	24 11 0	Mr. Royle
Bakewell	8	5	3 14 0	14 0 0	36 7 0	Dr. Johnstone.
Banbury	6	4	1 14 0	11 9 0	18 16 0	Mr. Royle.
Barnet	5	5	3 3 0	14 14 0	47 13 0	Dr. Fletcher.
Barnstaple	11	9	0 15 0	9 3 0	40 9 0	Mr. Royle.
Barrow-on-Soar ..	6	—	—	—	—	Dr. Darra Mair.
Barton-upon-Irwell.	7	6	3 15 0	21 0 0	60 1 0	„ Wheaton.
Bedwellty	7	6	13 14 0	55 15 0	145 16 0	„ Mivart.
Berkhampstead ..	3	3	3 12 0	8 3 0	18 3 0	„ Fletcher.
Bicester	7	5	0 12 0	6 14 0	16 2 0	Mr. Royle
Bideford	6	3	3 15 0	8 17 0	17 8 0	Do.

* This list does not include Oldham Union, and in this respect differs from the corresponding list in the Local Government Board's report, 1900-1901.

APP. A, No. 2.

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UNION.	No. of Vaccination Districts in the Union.	No. of Public Vaccinators recommended for Award.	Range of Awards in each Union. Minimum.	Range of Awards in each Union. Maximum.	Total Sum awarded in each Union.	Medical Inspector.
			£ s. d.	£ s. d.	£ s. d.	
Billericay	4	3	1 10 0	3 14 0	8 10 0	Dr. Fletcher.
Billesdon	3	1	—	—	6 0 0	" Darra Mair.
Birmingham (L.A.) ..	1	1	—	—	151 7 0	" Deane Sweeting
Bishop Stortford ..	7	5	1 5 0	7 15 0	19 16 0	" Fletcher.
Blaby	3	1	—	—	1 9 0	" Darra Mair.
Blofield	3	1	—	—	8 1 0	" Copeman.
Bolton	9	8	8 7 0	49 17 0	167 9 0	" Wheaton.
Bradfield	5	4	2 0 0	5 9 0	15 16 0	Mr. Royle.
Bradford (Yorks) ..	10	7	1 16 0	30 8 0	91 1 0	Dr. Johnstone.
Braintree	7	6	2 1 0	7 6 0	24 4 0	" Fletcher.
Bramley	6	4	5 5 0	21 14 0	54 0 0	" Johnstone.
Brentford	8	8	8 17 0	35 7 0	184 14 0	" Fletcher.
Bristol	8	8	6 9 0	29 15 0	105 12 0	" Deane Sweeting.
Bromsgrove	5	2	1 5 0	18 5 0	19 10 0	" Johnstone.
Bromyard	3	3	3 8 0	9 2 0	19 2 0	" Reece.
Buntingford	2	—	—	—	—	" Fletcher.
Caistor	8	3	3 4 0	4 19 0	12 4 0	Dr. Darra Mair.
Cambridge	1	1	—	—	35 14 0	" Copeman
Cardiff	9	6	1 2 0	58 12 0	117 18 0	" Deane Sweeting.
Cardigan	3	3	6 2 0	6 11 0	18 19 0	" Mivart.
Catherington	1	1	—	—	4 17 0	Mr. Royle.
Caxton and Arrington	4	4	2 5 0	7 16 0	23 9 0	Dr. Copeman.
Chapel-en-le-Frith ..	3	2	13 16 0	17 15 0	31 11 0	" Johnstone.
Chelmsford	9	9	1 12 0	11 13 0	43 19 0	" Fletcher.
Cheltenham	3	3	1 11 0	15 3 0	19 6 0	" Mivart.
Chepstow	5	5	1 6 0	10 9 0	32 0 0	Do.
Chester	3	3	1 5 0	53 6 0	58 2 0	Dr. Wheaton.
Chesterton	7	6	5 19 0	10 14 0	48 18 0	" Copeman.
Chichester	1	1	—	—	10 17 0	" Thomson.
Chipping Norton ..	4	2	2 11 0	3 1 0	5 12 0	Mr. Royle.
Chorley	5	4	8 8 0	18 15 0	45 4 0	Dr. Wheaton.
Chorlton	12	9	2 11 0	36 15 0	137 18 0	Do.
Church Stretton ..	4	3	1 11 0	2 17 0	6 9 0	Dr. Reece.
Cleobury Mortimer ..	2	2	2 10 0	3 13 0	6 3 0	Do.
Clun	4	4	0 18 0	3 10 0	8 2 0	Do.

UNION.	No. of Vaccination Districts in the Union.	No. of Public Vaccinators recommended for Award.	Range of Awards in each Union. Minimum.	Maximum.	Total Sum awarded in each Union.	Medical Inspector.
			£ s. d.	£ s. d.	£ s. d.	
Colchester	1	1	—	-	19 19 0	Dr. Fletcher.
Crediton	11	8	1 11 0	7 16 0	31 11 0	Mr. Royle.
Cuckfield	6	5	1 3 0	9 12 0	26 8 0	Dr. Thomson.
Darlington	5	4	2 6 0	26 13 0	34 5 0	Dr. Manby
Daventry	6	3	1 6 0	5 5 0	8 1 0	„ Darra Mair.
Devonport	2	-	—	—	—	Mr. Royle.
Dore	3	2	4 18 0	5 1 0	9 19 0	Dr. Reece.
Droitwich	6	5	0 17 0	13 17 0	38 8 0	„ Johnstone.
Droxford	4	3	3 13 0	7 8 0	17 10 0	Mr. Royle.
Dudley	9	8	3 18 0	53 12 0	185 0 0	Dr. Johnstone.
Dunmow	6	5	1 19 0	5 12 0	17 10 0	„ Fletcher.
Durham	5	3	15 17 0	34 7 0	79 16 0	„ Manby.
Easington	6	4	7 9 0	47 16 0	95 15 0	Dr. Manby.
Easingwold	5	3	3 12 0	5 19 0	13 4 0	„ Buchanan.
Easthampstead ..	4	—	—	—	—	Mr. Royle.
East Preston	3	3	6 13 0	17 5 0	30 15 0	Dr. Thomson.
East Stonehouse ..	1	1	—	—	11 2 0	Mr. Royle.
Ellesmere	6	5	1 14 0	3 1 0	11 12 0	Dr. Reece.
Ely	6	3	2 13 0	14 10 0	22 7 0	„ Copeman.
Epping	8	6	1 7 0	10 3 0	30 17 0	„ Fletcher.
Evesham	5	2	7 9 0	17 7 0	24 16 0	„ Johnstone.
Exeter	1	—	—	—	—	„ Deane Sweeting.
Faith, St.	5	5	2 9 0	5 14 0	21 9 0	Dr. Copeman.
Fareham	4	3	4 12 0	17 1 0	33 11 0	Mr. Royle.
Faringdon	4	3	3 11 0	7 6 0	15 9 0	Do.
Flegg, East and West	4	2	1 8 0	10 7 0	11 15 0	Dr. Copeman.
Forden	4	2	6 10 0	8 19 0	15 9 0	„ Wheaton.
Forehoe	6	4	0 17 0	13 5 0	21 15 0	„ Copeman.
Fulham	3	2	64 1 0	104 4 0	168 5 0	„ Deane Sweeting.
Fylde, The	5	4	2 16 0	16 1 0	38 4 0	Do.

APP. A, No. 2.

Inspection of Vaccination, and Awards to Public Vaccinators, 1900.

UNION.	No. of Vaccination Districts in the Union.	No. of Public Vaccinators recommended for Award.	Range of Awards in each Union. Minimum.	Range of Awards in each Union. Maximum.	Total Sum awarded in each Union.	Medical Inspector.
			£ s. d.	£ s. d.	£ s. d.	
Gainsborough.. ..	9	6	0 15 0	4 14 0	14 18 0	Dr. Darra Mair.
Garstang	3	2	4 16 0	7 9 0	12 5 0	" Wheaton.
Gateshead	5	4	25 2 0	94 0 0	175 0 0	" Manby.
George's, St.	3	3	6 7 0	44 16 0	88 7 0	" Deane Sweeting.
Giles, St., and St. Geo., Bloomsbury.	1	1	—	—	15 3 0	Do.
Glanford Brigg ..	10	9	0 10 0	9 10 0	34 7 0	Dr. Darra Mair.
Glossop	1	—	—	—	—	" Johnstone.
Gloucester	2	2	2 12 0	10 5 0	12 17 0	" Mivart.
Greenwich	2	2	49 7 0	83 6 0	132 13 0	" Deane Sweeting.
Guisborough	2	3	8 1 0	25 9 0	46 12 0	" Buchanan.
Halifax	10	3	5 5 0	14 5 0	25 6 0	Dr. Johnstone.
Halstead	5	5	1 18 0	9 2 0	25 18 0	" Fletcher.
Hammersmith ..	4	2	7 3 0	88 13 0	95 16 0	" Deane Sweeting.
Hampstead	1	1	—	—	33 14 0	Do.
Hartlepool	3	1	—	—	39 3 0	Dr. Manby.
Hastings	2	2	8 4 0	34 9 0	42 13 0	" Thomson.
Hatfield	3	3	1 17 0	6 19 0	11 16 0	" Fletcher.
Havant	4	4	2 6 0	6 0 0	17 0 0	Mr. Royle.
Haverfordwest ..	4	3	9 8 0	15 19 0	38 14 0	Dr. Mivart.
Hawarden	3	3	0 9 0	12 9 0	23 19 0	" Wheaton.
Hayfield	1	1	—	—	16 12 0	" Johnstone.
Helmsley	2	1	—	—	2 12 0	" Buchanan.
Hemel Hempstead ..	4	3	2 17 0	5 12 0	12 16 0	" Fletcher.
Henley	6	3	2 18 0	4 6 0	10 12 0	" Bulstrode.
Henstead	5	4	1 10 0	3 19 0	10 18 0	" Copeman.
Hereford	4	3	8 1 0	39 10 0	59 9 0	" Reece.
Hertford	5	3	3 10 0	15 12 0	23 15 0	" Fletcher.
Hinckley	4	2	1 15 0	1 16 0	3 11 0	" Darra Mair.
Hitchin	5	5	5 6 0	13 13 0	42 8 0	" Fletcher.
Holbeck..	1	—	—	—	—	" Johnstone.
Holborn..	5	3	0 4 0	21 4 0	42 4 0	" Deane Sweeting.
Holsworthy	5	3	3 11 0	10 0 0	17 6 0	Mr. Royle.
Holyhead	3	1	—	—	11 14 0	Dr. Wheaton.
Holywell	4	3	17 13 0	22 4 0	57 16 0	Do.

UNION.	No. of Vaccination Districts in the Union.	No. of Public Vaccinators recommended for Award.	Range of Awards in each Union. Minimum.	Range of Awards in each Union. Maximum.	Total Sum awarded in each Union.	Medical Inspector.
			£ s. d.	£ s. d.	£ s. d.	
Honiton	13	5	1 0 0	9 14 0	29 17 0	Mr. Royle.
Horncastle	7	6	3 10 0	8 1 0	33 11 0	Dr. Darra Mair.
Horsham	7	7	1 9 0	15 7 0	32 16 0	„ Thomson.
Houghton-le-Spring	3	3	8 14 0	9 14 0	27 18 0	„ Manby.
Hungerford and Ramsbury.	5	3	1 16 0	5 16 0	11 10 0	Mr. Royle.
Hunslet	4	4	3 15 0	66 0 0	92 4 0	Dr. Johnstone.
Hursley	1	1	—	—	5 9 0	Mr. Royle.
Keighley	5	3	0 19 0	5 2 0	9 17 0	Dr. Johnstone.
Kensington	3	3	30 2 0	67 6 0	156 8 0	„ Deane Sweeting.
Kidderminster ..	5	5	3 5 0	27 10 0	50 18 0	„ Johnstone.
Kingsbridge	7	5	2 2 0	8 6 0	23 15 0	Mr. Royle.
Kingsclere	3	3	2 18 0	7 2 0	13 10 0	Do.
King's Norton	7	3	5 6 0	24 18 0	41 11 0	Dr. Johnstone.
Kington	5	4	0 19 0	8 14 0	16 3 0	„ Reece.
Kirkby Moorside ..	1	1	—	—	4 16 0	„ Buchanan.
Knaresborough ..	3	1	—	—	2 19 0	„ Johnstone.
Knighton	5	4	2 11 0	7 12 0	16 10 0	„ Mivart.
Lampeter	2	2	7 1 0	7 4 0	14 5 0	Dr. Mivart.
Ledbury	4	3	9 7 0	11 5 0	30 9 0	„ Reece.
Leeds	7	7	1 0 0	39 11 0	144 13 0	„ Deane Sweeting.
Leigh	4	3	13 5 0	39 18 0	66 13 0	„ Wheaton.
Leominster	3	2	8 11 0	20 1 0	28 12 0	„ Reece.
Lewes	6	5	0 5 0	3 11 0	8 16 0	„ Thomson.
Lexden and Winstree	10	7	2 15 0	9 13 0	34 10 0	„ Fletcher.
Lincoln	12	9	1 18 0	27 0 0	68 14 0	„ Darra Mair.
Linton	3	2	7 6 0	10 15 0	18 1 0	„ Copeman.
Liverpool	3	3	33 5 0	77 5 0	160 1 0	„ Wheaton.
Llanfyllin	5	4	6 7 0	10 13 0	36 14 0	Do.
Llanrwst	3	3	4 9 0	8 17 0	20 3 0	Do.
Loughborough ..	4	4	2 5 0	3 16 0	13 3 0	Dr. Darra Mair.
Louth	11	6	0 6 0	10 14 0	35 4 0	Do.
Ludlow	5	5	2 6 0	11 13 0	23 15 0	Dr. Reece.
Lutterworth	5	3	0 18 0	4 7 0	8 5 0	„ Darra Mair.

APP. A, No. 8.

Inspection of Vaccination, and Awards to Public Vaccinators, 1900.

UNION.	No. of Vaccination Districts in the Union.	No. of Public Vaccinators recommended for Award.	Range of Awards in each Union. Minimum.	Range of Awards in each Union. Maximum.	Total Sum awarded in each Union.	Medical Inspector.
			£ s. d.	£ s. d.	£ s. d.	
Machynlleth .. .	4	2	5 13 0	6 1 0	11 14 0	Dr. Wheaton.
Maidenhead	4	4	0 13 0	14 3 0	29 15 0	Mr. Royle.
Maldon	8	4	2 15 0	7 19 0	17 16 0	Dr. Fletcher.
Malton	6	4	3 12 0	11 2 0	28 10 0	„ Buchanan.
Manchester	3	3	17 9 0	44 9 0	94 7 0	„ Wheaton.
Market Bosworth ..	6	5	1 0 0	4 3 0	12 5 0	„ Darra Mair.
Market Harborough	6	2	0 6 0	1 15 0	2 1 0	Do.
Martley	7	6	0 10 0	7 7 0	25 11 0	Dr. Johnstone.
Melton Mowbray ..	7	4	1 4 0	4 4 0	11 18 0	„ Darra Mair.
Middlesbrough ..	7	4	12 9 0	172 11 0	205 0 0	„ Buchanan.
Midhurst	4	4	3 12 0	6 4 0	20 2 0	„ Thomson.
Monmouth	6	6	2 8 0	15 0 0	41 12 0	„ Mivart.
Narberth	4	4	7 4 0	11 3 0	35 15 0	Dr. Mivart.
Newbury	3	2	3 6 0	4 10 0	8 5 0	Mr. Royle.
Newcastle-upon-Tyne.	4	3	51 17 0	70 18 0	181 6 0	Dr. Deane Sweeting.
Newent	4	3	4 4 0	5 10 0	14 4 0	„ Mivart.
Newmarket	8	6	2 6 0	26 4 0	64 10 0	„ Copeman.
Newport (Mon.) ..	12	10	0 8 0	63 9 0	210 18 0	„ Mivart.
Newport Pagnell ..	10	7	0 14 0	9 9 0	27 10 0	„ Fletcher.
Newton Abbot ..	13	13	1 19 0	20 14 0	91 17 0	Mr. Royle.
Newtown and Llanidloes.	4	1	—	—	5 9 0	Dr. Wheaton.
North Bierley.. ..	13	7	4 1 0	21 0 0	95 5 0	„ Johnstone.
North Witchford ..	4	3	8 14 0	11 1 0	29 2 0	„ Copeman.
Okehampton	6	6	1 5 0	7 9 0	23 3 0	Mr. Royle.
Olave, St.	3	3	31 12 0	40 7 0	107 6 0	Dr. Deane Sweeting
Ongar	4	4	2 4 0	4 4 0	13 8 0	„ Fletcher.
Orsett	5	4	1 5 0	7 11 0	17 5 0	Do.
Oswestry	5	4	4 1 0	21 11 0	45 8 0	Dr. Reece.
Ouseburn, Great ..	4	4	2 18 0	5 10 0	15 3 0	„ Johnstone.
Paddington	1	1	—	—	100 19 0	Dr. Deane Sweeting
Pateley Bridge ..	2	1	—	—	15 14 0	„ Johnstone.

UNION.	No. of Vaccination Districts in the Union.	No. of Public Vaccinators recommended for Award.	Range of Awards in each Union.		Total Sum awarded in each Union.	Medical Inspector.
			Minimum.	Maximum.		
			£ s. d.	£ s. d.	£ s. d.	
Pembroke	6	3	4 15 0	12 9 0	23 16 0	Dr. Mivart.
Pershore	5	5	2 0 0	11 2 0	27 0 0	„ Johnstone.
Petersfield	4	3	2 10 0	6 8 0	13 4 0	Mr. Royle.
Petworth	4	4	1 8 0	5 16 0	14 0 0	Dr. Thomson.
Pickering	3	1	—	—	4 13 0	„ Buchanan.
Plymouth (L.A.) ..	1	1	—	—	29 11 0	Mr. Royle.
Plympton St. Mary ..	5	2	5 19 0	6 4 0	12 3 0	Do.
Pontypool	6	5	5 13 0	38 0 0	84 5 0	Dr. Mivart.
Poplar	4	3	33 18 0	41 18 0	110 6 0	„ Deane Sweeting.
Portsmouth	1	1	—	—	102 14 0	Mr. Royle.
Potterspury	4	4	1 9 0	6 11 0	16 0 0	Dr. Darra Mair.
Prescot	7	6	8 6 0	131 15 0	411 16 0	„ Wheaton.
Preston	4	3	14 11 0	49 12 0	104 10 0	Do.
Prestwich	9	6	2 5 0	32 15 0	85 14 0	Do.
Reading..	1	1	—	—	11 8 0	Mr. Royle.
Rhayader	2	1	—	—	3 7 0	Dr. Mivart.
Ripon	4	2	3 10 0	5 15 0	9 5 0	„ Johnstone.
*Rochdale	6	5	2 0 0	21 1 0	35 9 0	„ Wheaton.
Rochford	7	2	2 11 0	6 6 0	8 17 0	„ Fletcher.
Romford	6	3	13 16 0	18 14 0	50 0 0	Do.
Romsey	5	—	—	—	—	Mr. Royle.
Ross	4	—	—	—	—	Dr. Reece.
Royston..	5	3	3 3 0	7 11 0	14 4 0	„ Fletcher.
Ruthin	3	1	—	-	6 6 0	„ Wheaton.
Rye	3	3	2 14 0	10 4 0	15 17 0	„ Thomson.
Saffron Walden ..	7	4	0 17 0	10 17 0	19 5 0	Dr. Fletcher.
Salford	5	3	9 0 0	56 15 0	85 17 0	„ Deane Sweeting
Salisbury	5	4	2 12 0	18 6 0	32 4 0	„ Mivart.
Saviour, St.	5	3	21 4 0	38 11 0	93 0 0	„ Deane Sweeting.
Scarborough .. .	6	6	1 15 0	8 11 0	27 12 0	„ Buchanan.
Sedbergh	3	—	—	—	—	„ Johnstone.
Sedgefield	4	2	14 19 0	17 8 0	32 7 0	„ Manby.
Seisdon	4	4	3 1 0	17 9 0	35 5 0	„ Reece.

* This union was inspected during the year 1899.

APP A, No. 2.

Inspection of Vaccination, and Awards to Public Vaccinators, 1900.

UNION.	No. of Vaccination Districts in the Union.	No. of Public Vaccinators recommended for Award.	Range of Awards in each Union. Minimum.	Range of Awards in each Union. Maximum.	Total Sum awarded in each Union.	Medical Inspector.
			£ s. d.	£ s. d.	£ s. d.	
Settle	7	2	0 9 0	1 16 0	2 5 0	Dr. Johnstone.
Sheffield..	8	8	8 11 0	48 19 0	178 0 0	„ Deane Sweeting.
Shipston-on-Stour ..	6	6	1 13 0	5 12 0	21 6 0	„ Johnstone.
Shoreditch	3	3	21 9 0	39 0 0	92 4 0	„ Deane Sweeting.
Skipton	8	2	4 5 0	4 10 0	8 15 0	„ Johnstone.
Smallburgh	4	3	5 6 0	10 19 0	24 16 0	„ Copeman.
Southampton (L.A.)..	2	2	19 10 0	56 0 0	75 10 0	Mr. Royle.
South Molton	9	8	1 0 0	6 10 0	27 2 0	Do.
South Shields	6	6	10 9 0	37 6 0	141 14 0	Dr. Manby.
South Stoneham ..	6	5	7 17 0	20 8 0	64 4 0	Mr. Royle.
Spilsby	7	5	3 10 0	7 18 0	29 10 0	Dr. Darra Mair.
Stepney	1	1	—	—	44 13 0	„ Deane Sweeting.
Steyning	6	5	2 6 0	17 8 0	39 8 0	„ Thomson.
Stockbridge	2	2	6 3 0	6 4 0	12 7 0	Mr. Royle.
Stockton	3	2	8 19 0	32 17 0	41 16 0	Dr. Manby.
Stokesley	4	4	2 16 0	7 14 0	23 2 0	„ Buchanan
Stourbridge	7	3	4 12 0	38 8 0	48 7 0	„ Johnstone.
Strand	1	1	—	—	6 14 0	„ Deane Sweeting.
Sunderland	6	5	13 9 0	28 9 0	111 16 0	„ Manby.
Tarvin	4	4	0 7 0	17 6 0	30 10 0	Dr. Wheaton.
Tavistock	8	6	2 11 0	11 10 0	37 0 0	Mr. Royle.
Teesdale	6	5	1 13 0	4 4 0	13 15 0	Dr. Manby.
Tenbury .. .	2	1	—	—	5 14 0	„ Johnstone.
Tendring	12	6	4 1 0	20 17 0	56 10 0	„ Fletcher.
Tewkesbury	4	1	—	—	0 14 0	„ Mivart.
Thakeham	2	1	—	—	5 14 0	„ Thomson.
Thomas, St.	15	13	0 13 0	22 2 0	80 4 0	Mr. Royle.
Ticehurst	8	6	0 12 0	5 4 0	14 0 0	Dr Thomson.
Tiverton .. .	12	8	0 8 0	6 5 0	24 8 0	Mr. Royle.
Todmorden	3	3	1 16 0	11 15 0	23 8 0	Dr. Johnstone.
Torrington	5	4	2 11 0	4 6 0	13 6 0	Mr. Royle.
Totnes	14	4	0 18 0	11 0 0	18 9 0	Do.
Towcester	4	4	2 4 0	4 2 0	13 3 0	Dr Darra Mair.
Toxteth Park	2	2	21 15 0	27 2 0	51 17 0	Deane Sweeting
Tregaron	2		4 18	10 0 0	14 18 0	Mivart.

UNION.	No. of Vaccination Districts in the Union.	No. of Public Vaccinators recommended for Award.	Range of Awards in each Union. Minimum.	Range of Awards in each Union. Maximum.	Total Sum awarded in each Union.	Medical Inspector.
			£ s. d.	£ s. d.	£ s. d.	
Upton-on-Severn ..	6	5	1 2 0	14 8 0	38 10 0	Dr. Johnstone.
Wallingford	4	4	2 5 0	7 12 0	19 9 0	Mr. Royle.
Wantage	6	5	2 11 0	6 19 0	20 13 0	Do.
Ware	8	7	0 6 0	9 3 0	26 5 0	Dr. Fletcher
Warrington	3	3	3 12 0	78 14 0	104 5 0	„ Wheaton.
Watford..	4	4	4 5 0	15 17 0	38 14 0	„ Fletcher.
Weardale	5	4	0 12 0	5 4 0	14 6 0	„ Manby.
Welwyn..	1	1	—	—	2 9 0	„ Fletcher.
Weobley	3	2	3 10 0	8 6 0	11 16 0	„ Reece.
Westbourne	3	3	1 9 0	5 9 0	10 3 0	„ Thomson.
Westbury-on-Severn	5	4	0 10 0	3 17 0	10 11 0	„ Mivart.
West Derby	9	5	12 11 0	48 8 0	167 15 0	„ Wheaton.
West Ham	9	8	25 10 0	76 3 0	400 13 0	„ Fletcher.
West Hampnett ..	6	5	2 18 0	7 3 0	26 4 0	„ Thomson.
Westminster	1	1	—	—	34 5 0	„ Deane Sweeting
Wetherby	6	4	2 15 0	10 1 0	25 9 0	„ Johnstone
Wharfedale	4	2	6 3 0	8 5 0	14 8 0	Do.
Whitby	4	1	—	—	10 4 0	Dr. Buchanan.
Whitchurch (Hants)	3	2	1 12 0	5 1 0	6 13 0	Mr. Royle.
Whitechapel	1	1	—	—	146 15 0	Dr. Deane Sweeting.
Whittlesey	2	1	—	—	5 4 0	„ Copeman.
Wigan	10	5	5 7 0	41 2 0	129 17 0	„ Wheaton.
Winchester, New ..	4	4	3 2 0	21 2 0	37 13 0	Mr. Royle.
Windsor..	3	2	6 19 0	16 18 0	23 17 0	Do.
Witney	4	4	4 3 0	10 19 0	33 3 0	Do.
Wokingham	5	2	1 3 0	4 6 0	5 9 0	Do.
Wolverhampton ..	6	3	28 18 0	46 19 0	107 10 0	Dr. Reece.
Worcester	1	1	—	—	10 9 0	„ Johnstone.
Wrexham	5	4	11 7 0	65 10 0	146 11 0	„ Wheaton
Yarmouth, Great ..	2	2	21 19 0	35 14 0	57 13 0	Dr. Copeman
Total	1,420	1,024	—	—	12,232 12 0	

App. A, No. 3.

National Vaccine Establishment, 1900.

No. 3.

STATISTICS OF THE NATIONAL VACCINE ESTABLISHMENT

I.—Educational Vaccination Stations.

In order to provide for the granting of those special certificates of proficiency in vaccination which are required to be part of the medical qualification for entering into contracts for the performance of public vaccination, or for acting as deputy to a contractor, the following arrangements are made:—

(1.) The vaccination stations enumerated in the subjoined list are open, under certain specified conditions, for the purposes of teaching and examination;

(2.) The vaccinators officiating at these stations are authorised to give the required certificate of proficiency in vaccination to persons whom they have sufficiently instructed therein; and

(3.) The vaccinators whose names in the subjoined list are printed in *italic letters* are also authorised to give such certificates, after satisfactory examination, to persons whom they have not themselves instructed.

Cities and Towns having Educational Vaccination Stations.	Places used as Educational Vaccination Stations.	Vaccinators authorised to give Certificates of Proficiency in Vaccination.	Days and Hours of Attendance of the Vaccinators at Stations where periodic Courses of Instruction are given (*a*).
London ...	St. Thomas's Hospital, Westminster Hospital	Dr. Albert Ernest Cope, 26, Bessborough Gardens, S.W.	Wed., 11.
	Tottenham Court Chapel, Tottenham Court Road.	*Mr. Joseph Loane* ... 98, Tressillian Road, St. John's, S.E.	Mon., Wed., 1.
	St. Mary's Hospital, Middlesex Hospital, St. George's Hospital	Mr. Edwin Climson Greenwood, 19, St. John's Wood Park, N.W.	Tuesday, 11. Friday, 3. Wed., 3.
	26, Bessborough Gardens, S.W.	Dr. Albert Ernest Cope, 26, Bessborough Gardens, S.W.	Mon., Thurs., 3.
	St. Olave's and St. John's Institute, Tooley Street, S.E.	Mr. Victor Alexander Jaynes, 157, Jamaica Road, Bermondsey, S.E.	Wed., 3.
	Eastern Dispensary, Leman Street.	Mr. Joseph Loane ... *See* above.	Wed., 11.
	144, Euston Road, N.W.	Miss Mary Thorne, M.D., 10, Nottingham Place, W.	Friday, 9.

(*a*) Candidates for the *Certificate by Examination* are recommended to communicate some days beforehand with the Examiner at whose station they propose to attend.

Candidates for the *Certificate after Instruction* should communicate with the authorised teacher to learn the dates of the regular courses of instruction.

I.—EDUCATIONAL VACCINATION STATIONS—*continued.*

Cities and Towns having Educational Vaccination Stations.	Places used as Educational Vaccination Stations.	Vaccinators authorised to give Certificates of Proficiency in Vaccination.	Days and Hours of Attendance of the Vaccinators at Stations where periodic Courses of Instruction are given (*a*).
Birmingham	Priory Rooms, Upper Priory.	*Dr. Edmund Robinson*... 213, Bristol Road, Edgbaston, Birmingham.	Monday, 1.30.
Bristol ...	St. Peter's Hospital, Bristol.	*Mr. George Shepley Page*, 78, Old Market Street, Bristol.	Wed., 11.
Cambridge..	University of Cambridge, East Street, Cambridge.	Mr. Joseph Leane ... 98, Tressillian Road, St. John's, S.E.	Friday, 11.
Cardiff ...	Roath Church Institute, Sun Street, Roath.	*Mr. John Llewellyn Treharne*, 92, Newport Road, Cardiff.	Tuesday, 11.
Leeds ...		(Vacant.)	
Liverpool ...	177, Mulgrave Street	*Mr. Nathaniel Edward Roberts*, 33, Mulgrave Street, Liverpool.	Tuesday, 3.
Newcastle-on-Tyne.	The Dispensary, Nelson Street.	*Dr. Frank Hawthorn* ... 6, Regent Terrace, Newcastle-on-Tyne.	Wednesday, 3.
Salford ...	Southern Hospital for Women and Children, Manchester.	*Dr. John Scott* ... ... 249, Upper Brook Street, Manchester.	Friday, 2.15.
Sheffield ...	250, Brook Hill, Sheffield.	*Mr. William Skinner* ... 250, Brook Hill, Sheffield.	Tuesday, 3.
Aberdeen ...	The Public Dispensary.	*Mr. Robert Gordon McKerron*, 1, Albyn Place, Aberdeen.	Wed., 2.30
Dundee ...	Royal Infirmary ...	Dr. Robert Cochrane Buist, 166, Nethergate, Dundee.	Thursday, 2.
Edinburgh	The Western Dispensary, Ponton Street.	*Dr. John Brown Buist*, 1, Clifton Terrace, Edinburgh.	Thursday, 3.
	The New Town Dispensary.	Dr. Francis Cadell ... 22, Ainslie Place, Edinburgh.	Tuesday, 12.

(*a*) Candidates for the *Certificate by Examination* are recommended to communicate some days beforehand with the Examiner at whose station they propose to attend.

Candidates for the *Certificate after Instruction* should communicate with the authorised teacher to learn the dates of the regular courses of instruction.

App. A, No. 3.

National Vaccine Establishment, 1900.

I.—Educational Vaccination Stations—*continued.*

Cities and Towns having Educational Vaccination Stations.	Places used as Educational Vaccination Stations.	Vaccinators authorised to give Certificates of Proficiency in Vaccination.	Days and Hours of Attendance of the Vaccinators at Stations where periodic Courses of Instruction are given (a).
Glasgow ...	The Royal Infirmary	*Mr. Robert Home Henderson*, 19, Elmbank Place, Glasgow.	Monday 12 (Women). Thursday, 12. (Men).
	The Western Infirmary.	Mr. John Wyllie Nicol, 7, Kersland Terrace, Glasgow.	Monday, 12.
Dublin ...	45, Upper Sackville Street.	*Dr. Alexander Nixon Montgomery*, 45, Upper Sackville Street, Dublin.	Tues., Fri., 10.

(a) Candidates for the *Certificate by Examination* are recommended to communicate some days beforehand with the Examiner at whose station they propose to attend.

Candidates for the *Certificate after Instruction* should communicate with t e authorised teacher to learn the dates of the regular courses of instruction.

II.—Animal Vaccine Station.

The Animal Vaccine Station is at 95, Lamb's Conduit Street, where Mr. T. S. Stott and Dr. Leslie Thorne Thorne attend for the Vaccination of Children on Tuesdays and Thursdays at 10.30 a.m.

III.—Distribution of Glycerinated Calf Lymph, 1900.

Number of applications from Public Vaccinators ... 50,512

Supplies sent out :—

Charged capillary tubes 444,221

No. 4.

REPORT on the OPERATIONS of the ANIMAL VACCINE ESTABLISHMENT at LAMB'S CONDUIT STREET during the year 1900–1901; by Mr. THOMAS S. STOTT, Director.

APP. A, No. 4. On the Operations of the Animal Vaccine Establishment, 1900-1901; by Mr. Stott.

During the year April 1st, 1900, to March 31st, 1901, 155 calves were vaccinated. The aggregate weight on reception at Lamb's Conduit Street of the 155 calves was 43,964 lbs. On dismissal from the station their aggregate weights were 45,301 lbs., so that during retention for vaccination purposes they gained in weight by an average of 8·62 lbs.

Of the above calves, 142 were vaccinated direct from other calves, and 13 were vaccinated from calf lymph which had been stored. As usual, vaccinations performed with direct lymph proved more successful than the others. Insertions to the number of 6,697 in calf-to-calf operations produced 6,521 vesicles; in the 13 cases vaccinated from lymph stored in tubes, 513 insertions produced 440 vesicles, giving rates of insertion respectively of 97·37 and 85·77 per cent.

No material difference in the results of calf-to-calf vaccinations was observed, whether the lymph used was from calves vaccinated 96 hours, or from calves vaccinated 120 hours previously; in either case the rate of insertion was practically 97 per cent.

Primary Vaccinations.—During the year 1900 to 1901 there were performed 1,892 primary vaccinations, five separate insertions of lymph being made in each instance. Of the persons thus vaccinated 934 were males and 958 were females. All but 13 of the primary vaccinations succeeded at the first attempt. There were 374 primary vaccinations from calf-to-arm. Of these persons primarily vaccinated by the several staff operators three failed to return for inspection. Of the 371 remaining, 347 on examination were found to have taken in five places, 19 in four, 3 in three, 1 in two places, and 1 failed on the first attempt. The insertion success rate, therefore, was 98·22 per cent. The remaining primary vaccinations were performed with glycerinated calf lymph.

Revaccinations.—These numbered 1,121, of which 902 were performed from calf-to-arm, of which cases seven failed to return for inspection. Of the remaining 895 cases, 805 on inspection were successful in five places, 44 in four, 13 in three, 13 in two, 10 in one, and 10 failed, giving an insertion success rate of 95·55 per cent. The remaining 219 revaccinations were performed with glycerinated calf lymph.

There were 11 cases brought back after inspection on account of some abnormal course of their vaccination. In the majority of these the abnormality consisted of "sore arm," in most instances caused by domestic maltreatment.

Having regard to the falling off in numbers of the primary vaccinations, 1,892 during 1900–1901, as against 2,615 in 1899–1900, I attribute this, in part, to the domiciliary vaccinations performed by the public vaccinators, but in a much greater degree to the fact that, in many instances, for some reason at present unexplained, the notification of vaccination being performed at the Animal Vaccine Establishment has been omitted from the vaccination papers supplied to the public by the Registrars.

No. 5.

App. A, No. 5.

On the Operations of the Glycerinated Calf Lymph Establishment, 1900-1901; by Dr. Blaxall

REPORT on the OPERATIONS of the GLYCERINATED CALF LYMPH ESTABLISHMENT, 1900-1901; by Dr. FRANK R. BLAXALL.

The experience afforded by the work of the Glycerinated Calf Lymph Establishment during 1899-1900 led to the increase of the staff by—

1 Assistant Bacteriologist,
1 Laboratory assistant,
2 Laboratory boys,
2 Assistant clerks.

The rooms occupied by the Department at the Jenner Institute of Preventive Medicine were increased in number by—

1 Laboratory,
1 Clerks' room,
1 Basement room for sterilising purposes.

Further, the accommodation for calves has been altered by giving up the Harpur Mews premises and extending the existing stabling at Little James Street. This arrangement has enabled me to group the calves in two establishments instead of having them scattered over three.

The amount of glycerinated calf lymph despatched during the year ending March 31st, 1901, was 443,272 tubes, each containing sufficient lymph for one vaccination.

The demands have been fairly evenly distributed over the year, and, owing to the absence of any outbreak of small-pox in England or Wales, we have experienced at no period such excessive calls as occurred last year.

The results of the use of the lymph during the year for the 420,425 cases, of which report has been sent in, show 97·7 per cent. case success, and 91·2 per cent. insertion success.

Summaries of the issue and results are set forth in the appended Tables I. and II.

The lymph thus issued was derived from 362 calves. All these animals, after slaughter, were examined by our veterinary surgeon and certified to be healthy. Four other calves, which appeared to be in health during the course of vaccination, were found at the autopsy to exhibit evidence of slight tubercular lesions in certain glands. The lymph from these calves was at once destroyed.

The bacteriological examination of every lymph has been systematically carried out as heretofore, and in furtherance of our knowledge concerning the flora associated with calf lymph, their biological attributes and potentialities, and in regard to the vitality possessed by the vaccine virus itself under varied influences, much work has been done—work which I believe will greatly aid in the attainment of increased efficiency.

Reports on these subjects by Mr. H. S. Fremlin, Dr. A. B. Green, and myself appear in Appendix C.

Table I.

Showing number of Tubes of Glycerinated Calf Lymph sent from Laboratories to National Vaccine Establishment for Distribution to Public Vaccinators during the year ended 31st March, 1901.

Week ended		Number.	Monthly number.	Quarterly number.
1900.				
April	7	7,816	1900.	
	14	6,380	April, 33,972	
	21	6,850		
	28	10,626		
May	5	10,640		
	12	10,840		1900, Second Quarter, 119,002.
	19	10,350	May, 44,950	
	26	9,450		
June	2	7,940		
	9	8,620		
	16	9,460	June, 40,080	
	23	10,850		
	30	9,180		
July	7	8,690		
	14	7,640		
	21	7,420	July, 34,210	
	28	7,210		
August	4	8,430		
	11	7,160	August, 37,490	1900. Third Quarter, 110,010.
	18	8,880		
	25	8,990		
September	1	9,400		
	8	9,210		
	15	9,840	September, 38,310	
	22	9,700		
	29	8,300		
October	6	8,110		
	13	8,270		
	20	8,950	October, 39,160	
	27	9,330		
November	3	8,200		
	10	8,220		1900, Fourth Quarter, 104,535.
	17	8,675	November, 36,975	
	24	8,330		
December	1	9,250		
	8	9,300		
	15	8,550	December, 28,400	
	22	5,000		
	29	3,000		
1901.				
January	5	7,200	1901.	
	12	7,550	January, 37,060	
	19	8,500		
	26	8,950		
February	2	7,200		
	9	8,800	February, 33,750	1901, First Quarter, 109,725.
	16	8,700		
	23	8,750		
March	2	8,750		
	9	9,700		
	16	10,350	March, 38,925	
	23	9,350		
	30	7,275		
Totals ..		443,272	443,272	443,272

App. A, No. 5.

On the Operations of the Glycerinated Calf Lymph Establishment, 1900-1901; by Dr. Blaxall.

TABLE II.

Showing results of the use of GLYCERINATED CALF LYMPH issued during the Year ended 31st March, 1901.

TOTAL CASES.

Period during which sent out	Number of cases used for.	Percentage success.	
		Case.	Insertion.
June Quarter 1900	113,954	98·4	93·2
September „ „	104,413	96·1	87·3
December „ „	97,107	97·3	90·1
March „ 1901	104,951	98·8	93·8
Total	420,425	97·7	91·2

PRIMARY CASES.

Period during which sent out.	Number of cases used for.	Percentage success.	
		Case.	Insertion.
June Quarter 1900	110,385	98·5	93·2
September „ „	102,388	96·1	87·4
December „ „	93,805	97·3	90·1
March „ 1901	102,077	98·8	93·8
Total	408,655	97·7	91·2

REVACCINATIONS.

Period during which sent out.	Number of cases used for.	Percentage success.	
		Case.	Insertion.
June Quarter 1900	3,569	96·5	92·7
September „ „	2,025	92·9	84·7
December „ „	3,302	97·6	92·3
March „ 1901	2,874	97·1	91·8
Total	11,770	96·3	91·0

No. 6.

SUMMARY of the WORK of the MEDICAL INSPECTORS during the YEAR 1900.

APP. A, No. 6.

Summary of Work of Medical Inspectors during the year 1900.

A. DISEASE AND SANITARY ADMINISTRATION.

The following sanitary districts were visited by the Medical Inspectors with special reference to outbreaks of infectious disease of one and another sort, and to general sanitary circumstances and administration, viz. :—

Name of District.	Nature of Inquiry.
†‡Bishop Auckland, U.D.	Sanitary state and administration.
†‡Boston, U.D.	Do. do.
†Crickhowell, R.D., part of (Llangattock)	Diphtheria.
†Failsworth, U.D.	Sanitary state and administration.
†Farnworth, U.D.	Enteric fever.
Gainsborough, U.D.	Small-pox.
Do. R.D.	Do.
Grimsby, U.D.	Do.
†‡Hexham, U.D.	Typhus fever.
Horncastle, R.D.	Small-pox.
†Kearsley, U.D.	Enteric fever
Leicester, U.D.	Diphtheria.
†Machynlleth, R.D., part of (Pennal) ...	Sanitary state and administration.
†‡Nailsworth, U.D.	Do. Do.
†‡Northam, U.D.	Do. Do.
†‡Nuneaton and Chilvers Coton, U.D. ...	Enteric fever.
†Pontypridd, U.D.	Diphtheria.
†Prestwich, U.D.	Diphtheria and scarlatina.
†Romney Marsh, R.D.	Sanitary state and administration.
Stalybridge, U.D.	Small-pox.
†‡Stroud, R.D.	Sanitary state and administration.

* Throughout this summary the following abbreviations are used :—U.D. = a Borough or Urban District. R.D. = Rural District. P.S.D. = Port Sanitary District. Jt.H.D. = A Joint District for hospital purposes, formed under the Public Health Act, 1875, or the Isolation Hospitals Act, 1893.

† *See* Appendix A, No. 7, p. 67.

‡ The reports on these districts are reproduced in full in this volume, *see* Appendix A, Nos. 8 to 13.

App. A, No. 6.

Summary of Work of Medical Inspectors during the year 1900.

B. Hospitals, &c.

Local inquiries were held by the Medical Inspectors in connection with the provision of hospital accommodation for :—

Aldershot, U.D.
Aston Manor, U.D.
Barry, U.D.
Bournemouth, U.D.
Braintree, Jt.H.D.
Bromley and Beckenham, Jt.H.D.
Burnley, Jt.H.D.
Cambridge, U.D.
Chailey, R.D.
Chepping Wycombe, U.D.
Chiddingstone, Jt.H.D.
Chingford, Woodford, Buckhurst Hill, and Waltham Holy Cross, U. Districts.
Conway, U.D.
Croydon, U.D.
Darwen, U.D.
Doncaster, R.D., and Mexborough, U.D.
Dover, U.D.
Eastbourne, U.D.
Eastleigh and Bishopstoke, U.D.
Enfield, U.D.
Epping, U.D.
Epsom, R.D., Sutton, Carshalton, and Leatherhead, Jt.H.D.
Fareham, U.D.
Felling, U.D.
Folkestone, U.D.
Great Grimsby, U.D.
Great Yarmouth, U.D.
Hampton, U.D.
Hanley, Stoke, and Fenton, Jt.H.D.
Hythe, U.D.
Isle of Wight, R.D.
Keighley and Bingley, Jt.H.D.
Kings Norton and Northfield, U.D.
Lathom and Burscough, U.D., and Ormskirk, U.D.
Leeds, U.D.
Maidstone, U.D.
Manchester, U.D.
Middlesbrough, U.D.
Newburn, U.D.
Newcastle - under - Lyme, U.D.
Newton Abbot, Jt.H.D.
Ongar, R.D.
Orsett, R.D.
Oystermouth, U.D.
Penarth, U.D.
Salford, U.D.
Seaford, U.D.
Shardlow, Jt.H.D.
Sheffield, U.D.
Sittingbourne and Milton, Jt.H.D.
Southall-Norwood, U.D.
Southgate, U.D.
Stroud, Jt.H.D.
Swindon and Highworth, Jt.H.D.
Wallasey, U.D.
Wells (Som.), U.D.
Wharfedale, Jt.H.D.
Whickham, U.D.
Wigan, U.D.
Wimbledon, U.D.
Winchester, U.D.
Wirral, Jt.H.D.
Wolstanton, R.D.
Workington, U.D.

Inquiries were held with reference to the provision of disinfecting apparatus for Merthyr Tydfil and Scarborough Urban Districts. Loans for the provision of shelters for the temporary accommodation of families during the disinfection of their dwellings necessitated inquiries at Bermondsey and Hackney.

App. A, No. 6.

Summary of Work of Medical Inspectors during the year 1900.

C. Sewerage and Sewage Disposal.

Medical Inspectors were associated with Engineering Inspectors of the Board in formal inquiries held with reference to sewage disposal in—

Brierfield, U.D.	Rotherham, R.D.
Exeter, U.D.	Yeovil, U.D.
Hythe, U.D.	

A formal inquiry was also held as to the desirability of declaring the tidal waters of the River Exe "a stream" within the meaning of the Rivers Pollution Prevention Acts.

D. Water Supply.

Local inquiries as to questions affecting water supplies were held at—

Carnarvon, U.D.	Leiston-cum-Sizewell, U.D.

E. Scavenging.

Inquiries of one and another sort concerning the removal of refuse, and the proper cleansing of privies, cesspools, and ashpits, were held in—

Eton, R.D.	Tynemouth, R.D.
Llantrisant and Llanwitvardre, R.D.	West Ham, U.D.

F. Byelaws.

Inquiries as to the desirability of adopting the Board's model series of Byelaws, or certain modifications thereof, were held in—

Cuckfield, R.D.	Widnes, U.D.
Salisbury, U.D.	Willesden, U.D.
Totnes, R.D.	

G. Vaccination Inspection.

In addition to the routine biennial inspection of vaccination in England and Wales (App. A, No. 2), formal inquiries were held as to the performance of their duties of three vaccination officers in the Blaby, Chorlton, and Medway Unions, and as to two Public Vaccinators in the Lanchester and Ross Unions. In the Lanchester case the inquiry also had reference to the performance of the Officer's duty in his capacity as Medical Officer of Health for Consett, U.D. Special visits by Medical Inspectors with reference to vaccination administration were made to the following unions:—

Blaby.	Lambeth.
Chorley.	Leicester.
City of London.	Marylebone.
Derby.	Mile End.
Hampstead.	Monmouth.
Holborn.	Shoreditch.
Kensington.	St. Pancras.
King's Lynn.	Whitby.

APP. A, No. 6.

Summary of Work of Medical Inspectors during the year 1900.

H. PLAGUE PRECAUTIONS.

In this connection the following port and riparian districts were visited by the Medical Inspectors, viz. :—

Barnstaple, P.S.D.
Barrow-in-Furness, U.D.
Barry, P.S.D.
Beaumaris, P.S.D.
Berwick-on-Tweed, U.D.
Blyth, P.S.D.
Bridgwater, P.S.D.
Bridport, U.D.
Bristol, P.S.D.
Cardiff, P.S.D.
Chester, P.S.D.
Conway, R.D.
Dartmouth and Totnes, P.S.D.
Dover, U.D.
Exeter, P.S.D.
Falmouth and Truro, P.S.D.
Fleetwood, P.S.D.
Fowey, P.S.D.
Gloucester, P.S.D.
Grimsby, P.S.D.
Hartlepool, P.S.D.
Holme Cultram, U.D.
Holyhead, U.D.
Hull and Goole, P.S.D.
Ipswich, P.S.D.
Kidwelly, U.D.
King's Lynn, P.S.D.
Lancaster, P.S.D.
Liverpool, P.S.D.
Llanelly, R.D.
Do. U.D.
London, P.S.D.
Lowestoft, P.S.D.
Lyme Regis, U.D.
Manchester, P.S.D.
Maryport, U.D.
Milford, P.S.D.
Millom, U.D.
Morecambe, U.D.
Newhaven, P.S.D.
Newport (Mon.), P.S.D.
Padstow, P.S.D.
Plymouth, P.S.D.
Poole, P.S.D.
Portsmouth, P.S.D.
Preston, P.S.D.
Southampton, P.S.D.
St. Asaph, R.D.
Sunderland, P.S.D.
Swansea, P.S.D.
Tees, P.S.D.
Teignmouth, P.S.D.
Tyne, P.S.D.
Whitehaven, U.D.
Workington, P.S.D.
Yarmouth, P.S.D.
Ynyscynhaiarn, U.D.

With reference to plague-administration, and in view of likelihood of demand for prompt action in the matter of suspected importations or developments of that disease, a senior Medical Inspector has week by week continued to take "plague-duty" each Sunday. In the above sense each such Inspector in turn is in charge of the department for plague purposes from Saturday afternoon until resumption of office work on Monday.

Dr. Thomson visited Glasgow to observe the administrative measures that were there being adopted to combat the epidemic.

Dr. Buchanan, in association with Dr. Downes, visited various hospitals belonging to the Metropolitan Asylums Board, with a view to determining beforehand the provision that should be made for dealing with any cases that should occur in the metropolis. Suspected cases of *imported* plague were locally investigated at the following ports :—Cardiff, King's Lynn, London, River Tyne, and Rochester.

I. Conferences with Local Officials.

Conferences were held with local officials of—

Aldershot, U.D.	New Forest, R.D.
Banbury, U.D.	Rotherhithe Vestry.
Boston, U., R., and P.S. Districts.	Sedgefield, R.D.
Chester-le-street, R.D.	Wakefield, R.D.
East Ham, U.D.	West Hartlepool, U.D.
Falmouth, P.S.D.	Whittlesey, U. and R. Districts.
Kidsgrove, U.D.	Withnell, U.D.
Lanchester, R.D.	Wortley, R.D.
Milford, P.S.D.	

K. Miscellaneous.

Dr. Thomson was appointed a member of the Committee to inquire into the Sanitary State of Dublin.

Dr. Bulstrode commenced during the year a re-inspection of certain oyster layings round the coast, and his inquiry has been extended so as to embrace other shell-fish.

Dr. Thomson presided at a Conference of Representatives of the Sanitary Authorities comprised within the Epsom and Dorking Unions convened to consider the question of the appointment of a joint Medical Officer of Health.

Dr. Thomson attended, as the representative of the Local Government Board, the International Congress of Hygiene and Demography held at Paris during the summer.

Dr. Buchanan, towards the close of the year, inquired into a severe epidemic of arsenical poisoning attributed to the consumption of beer brewed from materials contaminated with arsenic. Dr. Buchanan was, in the later stages of his inquiry, assisted by Dr. Mair.

L. Inquiries by the Assistant Inspector in the Medical Department.

Mr. C. J. Huddart, the non-professional Assistant Inspector attached to the Medical Department, made inquiry between the date (August) of his appointment and the end of the year into the adequacy and suitability of the appointments of Inspectors of Nuisances in the following districts:—

Auckland, R.D.	Ludlow, R.D.
Asygarth, R.D.	Do. U.D.
Axminster, R.D.	Rotherham, R.D.
Carlisle, R.D.	Scarborough, R.D.
Clun, R.D.	Stanhope, U.D.
Driffield, R.D.	Walker, U.D.

Inquiry into the arrangements for the disposal of refuse engaged his attention in the Buckley and Stanhope Urban Districts. Mr. Huddart visited the unions named below to inquire generally as to the administration of the Vaccination Acts therein, especially with reference to the performance of their duties by the Vaccination Officers. His inquiries in this respect generally followed an unsatisfactory report by a Medical Inspector after the usual biennial visit to the union.

Axminster.	Redruth.
Bath.	St. Asaph.
Blaby.	St. Austell.
Carnarvon.	St. Columb Major.
Clun.	St. Thomas.
Devizes.	Shifnal.
Falmouth.	South Stoneham.
Frome.	Tiverton.
Glanford Brigg.	Trowbridge and Melksham.
Liskeard.	Truro.
Oswestry.	Wellington (Salop).

No. 7.

ABSTRACT of MEDICAL INSPECTIONS made in 1900 with regard to the INCIDENCE of DISEASE on particular places, and to questions concerning LOCAL SANITARY ADMINISTRATION.

[The reports relating to districts indicated by an asterisk are reproduced in this volume, see App. A, Nos. 8–13.]

1. *BISHOP AUCKLAND (DURHAM); population (1891), 10,097; Dr. Wheaton.

Authority concerned: Bishop Auckland Urban District Council.

Ground of Inquiry: Prevalence of enteric fever—complaints of Durham County Council as to the sanitary condition of the town.

Chief Facts reported by Inspector: Enteric fever prevalent in the district for many years; in 1898, 138 attacks of enteric fever, with 14 deaths; in 1899, 157 attacks and 26 deaths; also 7 attacks of continued fever, with 1 death, and 8 attacks of typhus fever. In 1900 up to December 6th, 28 attacks of enteric, with 5 deaths, and 5 of continued fever, with 1 death.

General sanitary condition of district very unsatisfactory. Water supply from River Wear, which is much polluted by sewage; occasionally supplied unfiltered. Condition of dwellings in the older parts of the town very unsatisfactory. Sewerage very unsatisfactory; old tile and rubble sewers; no treatment of sewage before discharging it into watercourses. House drainage often defective. Excrement disposal by midden privies of unsuitable construction, and by water-closets. Scavenging unsatisfactory; contents of privies thrown on streets and yards. Slaughter-houses—condition very unsatisfactory in some instances, as also that of cow-sheds. Condition of common lodging-houses unsatisfactory. Isolation provision inadequate; not suitable for treatment of more than one form of infectious disease at a time. No disinfecting apparatus.

The enteric fever prevalence probably due to its distribution from time to time by means of a contaminated water supply, and subsequent spreading facilitated by general insanitary condition of the town.

2. *BOSTON (LINCOLNSHIRE); population (1891), 14,570; Dr. S. Monckton Copeman.

Authority concerned: Boston Town Council.

Ground of Inquiry: Increased prevalence of enteric fever and diarrhœa; and non-compliance with recommendations resulting from previous official inspections.

Chief Facts reported by Inspector: Continued and increasing prevalence of both diseases. Enteric fever in 1898 specially localised on west side of town, but more generally distributed in 1899.

The sewerage of the town on the east side discharges to the Barditch, an ancient drain now covered in, and to the Maud Foster Drain, an open canal. On the west the sewerage, owing to want of fall, has become completely choked. An entirely new sewerage system for the whole town is urgently required.

Hospital provision is inefficient, and neither Urban, Port, or Rural Authorities possess an apparatus for disinfection. New code of byelaws urgently required. Dairies, Cow-sheds, and Milkshops Order of 1885–1886, not enforced.

3. FAILSWORTH URBAN DISTRICT (LANCASHIRE); population (1891), 10,425; Dr. Fletcher.

Authority concerned: Failsworth Urban District Council.

Ground of Inquiry: Supposed inadequate remuneration of the Medical Officer of Health.

Chief Facts reported by Inspector: Water supply obtained from the water-mains of the Oldham Corporation. The water is derived from gathering grounds and is supplied unfiltered. Houses, generally, provided with drainage, and usually "disconnected" from sewers. About one-eighth of the houses (in the older part of the district) drain to old sewers discharging into watercourses; about seven-eighths of the houses to new sewers constructed by loan sanctioned by the Board. These are ventilated by street gratings and shafts, but there are no special flushing arrangements. The sewage disposal works have been properly planned and constructed, but are not used to the best advantage. No land treatment, but a scheme since sanctioned by the Board. Excrement and house-refuse disposal—mainly by open privy-middens and pail-closets; water-closets, waste-water closets, and a very few hand-flushed closets exist. Excrement and house-refuse removed, fairly satisfactorily, by the Council's men. No common lodging-houses. Eighteen registered cow-keepers and purveyors of milk. No isolation hospital, but agreement in force as to use of Oldham isolation hospital, and not a few patients sent there.

The District Council have two good officers, but the Medical Officer of Health is underpaid and the Inspector

of Nuisances is leaving, tempted elsewhere by a larger salary. Much good work is being done in the district.

4. Farnworth (Bolton) Urban District (Lancashire); population (1891), 23,758; Dr. Fletcher.

Authority concerned: Farnworth Urban District Council.

Ground of Inquiry: Prevalence of enteric fever. The Medical Officer of Health, not being under the Board's Order, did not submit to the Board copies of his annual reports.

Chief Facts reported by Inspector: Water supply obtained from the water-mains of the Bolton Corporation, whose gathering ground is not free from risk of contamination. House-drains generally "disconnected" from sewers, but "trapping" sometimes unsatisfactory. Few houses unprovided with drains discharging to the sewers. The latter, apparently, well constructed, but ventilation might be improved, and special arrangements for flushing are absent. Sewage disposal works deficient as regards filter-beds, but these are under construction. Excrement and house-refuse disposal unsatisfactory; privies with deep ashpits almost universal. Removal of nightsoil and house-refuse by Council's own men, horses, and carts, but not altogether satisfactorily performed. Common lodging-houses not satisfactory. No register of cowkeepers and purveyors of milk. There is a well-equipped isolation hospital, and it is freely used. Enteric fever has for some years past been endemic without at any time assuming epidemic proportions; probably it has been fostered by the system of excrement disposal in vogue in the district.

5. *Hexham (Northumberland); population, 7,000; Dr. Manby.

Authority concerned: Hexham Urban District Council.

Ground of Inquiry: Outbreak of typhus fever.

Chief Facts reported by Inspector: An outbreak of 30 cases in Hexham and two cases outside. Infection probably imported by the family of a woman dying from an undiagnosed disease at a gipsy encampment some miles away. Definite chain of infection established as regards subsequent cases. First case in Hexham beginning of July, last case beginning of October. Majority of cases first week in September. Energetic action by prompt isolation of all possible cases, school closure, and provision of ample hospital accommodation, rapidly coped with the outbreak. All cases except five occurred in some insanitary and over-crowded property in a low part of the

town. No spread from the five discrete cases. Mortality, 4 out of 30 Hexham cases, and 1 out of 2 early ones; all 5 people over 40.

Sanitary Authority taking steps to remove insanitary conditions of property in Hexham. A steam disinfector badly wanted.

6. Kearsley Urban District (Lancashire); population (1891), 7,993; Dr. Fletcher.

Authority concerned: Kearsley Urban District Council.

Ground of Inquiry: Prevalence of enteric fever. The Medical Officer of Health has not been under the Board's Order, but he has, nevertheless, sent copies of his annual reports to the Board. These, however, were deficient as regards the kind of information desired by the Board.

Chief Facts reported by Inspector: Water supply obtained from the water-mains of the Bolton Corporation, whose gathering ground is not free from risk of contamination. House-drains generally "disconnected" from sewers, but not always in a satisfactory manner. Few houses unprovided with drains discharging to the sewers. The latter are, apparently, well constructed, but ventilation might be improved. No special means of flushing. Sewage outfall works deficient in arrangements for land-treatment of effluent from filter-beds. Excrement disposal, also house refuse disposal, by privies with deep ashpits; removal by contract not satisfactory. No common lodging-house. No register of cowkeepers and purveyors of milk. No isolation hospital, but patients occasionally sent to the Salford Isolation Hospital, where three beds are reserved for Kearsley.

Enteric fever has been endemic in Kearsley during 1899; reliable information for preceding years not obtainable, as the Notification Act was not in force until January 1st, 1899. Probably the disease has been fostered by the numerous insanitary privy-middens.

7. Llangattock Village (Llangattock) (Brecon); population (1891) of parish, 2,394; of village, about 320; Dr. Wheaton.

Authority concerned: Crickhowell Rural District Council.

Ground of Inquiry: Prevalence of diphtheria.

Chief Facts reported by Inspector: Diphtheria has prevailed in the village for a considerable time. Since September 14th, 1899, up to date of visit on November 8th

104 attacks of diphtheria have occurred in the parish, with 15 deaths. The disease arose under very unwholesome surroundings in an insanitary quarter of the village known as the Loan; its subsequent spread in part due to attendance at the school in the village of children from the village and surrounding hamlets. Sore throat prevalent in the village. School closed on several occasions on account of the diphtheria prevalence. Many unrecognized cases among children. Sanitary condition of the village very unsatisfactory. Water supply from springs piped to two points in the village; but many dwellings are situate at an inconvenient distance from the taps and little water available for flushing drains. No sewers; drainage defective; house drains discharging into streams or highway drains, or altogether wanting. Great nuisance from decomposing sewage retained in highway drains. Excrement disposal by cesspit privies, not watertight; contents soaking into the ground or conveyed by pipes to highway drains. No collection of refuse, which is thrown in heaps in gardens or on the banks of streams. No hospital provision; no disinfecting apparatus provided.

8. *NAILSWORTH URBAN DISTRICT (GLOUCESTERSHIRE); population (estimated), 3,200; Dr. Mivart.

Authority concerned: Nailsworth Urban District Council.

Ground of Inquiry: General sanitary circumstances and administration. Complaint by contiguous Rural District Council of Stroud as to contamination of streams, and refusal of Nailsworth Urban District Council to formulate any sewerage scheme.

Chief Facts reported by Inspector: Water supply to large extent precarious and scanty in summer. No definite system of sewerage. Numerous short sections of sewer pipe, all discharging into the stream flowing through town or into a pond communicating with streams and causing dangerous nuisance. Excrement disposal by discharge into stream or throwing on small gardens. Slaughter-houses, dairies, cowsheds, and milkshops unregistered and urgently needing supervision. No byelaws or regulations of any kind. Infectious Disease (Notification) Act, 1889, Infectious Disease (Prevention) Act, 1890, and Parts II. and III. of Public Health Acts Amendment Act, 1890, adopted. No infectious diseases hospital. No disinfector. Local authority obstinate in refusing to entertain any sewerage and drainage scheme, and in asserting that the streams are practically untainted by the district sewage owing to its small quantity.

9. *NORTHAM URBAN DISTRICT (DEVONSHIRE); population (1891), 5043; Dr. R. J. Reece.

Authority concerned: Northam Urban District Council.

Ground of Inquiry: Annual and special reports of Medical Officer of Health deficient in information as to sanitary condition of district and as to work done by him, and of measures of sanitary improvement required to be carried out in the district.

Chief Facts reported by Inspector: Previous inquiries by Medical Department of the State in 1871 and 1894. Division of district for practical purposes into five sub-areas:—(1) Appledore; a seaport. (2) Northam; a good-sized country village. (3) Orchard Hill; a residential neighbourhood. (4) Westward Ho; a seaside resort. (5) Northern Ridge; a detached portion of the district, purely rural in character. Dwellings of many different types; cottage property—eavespouting defective, and many houses damp. Some back to back houses at Appledore; Westward Ho! and Orchard Hill almost free from insanitary property. 64 per cent. of houses in the district rated under £5 per annum and 11 per cent. over £20. Courts and yards often imperfectly paved and drained, but improvement since 1894. Water-supply inadequate; mostly from shallow wells liable to pollution. After persistent pressure from the Board and complaints from inhabitants a large water-supply scheme has now been undertaken. Sewerage—Appledore: Some improvement since 1894; sewers discharge on to foreshore; house drainage defective in places, in others altogether absent. Excrement disposal—mostly by ill-constructed, badly-placed midden privies. Cleansing these devolves on householder, and is often neglected. Some hand-flushed w.c.'s. Many houses unprovided with privy accommodation. Northam: Some new sewers laid; old rubble drains still used for sewage; two outfalls to meadow land. House drainage often defective. Excrement disposal—by hand-flushed w.c.'s and ill-constructed midden privies. Orchard Hill: Efficiently sewered; outfall to tidal river Torridge. Westward Ho!: Sewered in 1870–1; no means for inspection, flushing, or ventilation; outfall through golf links to the sea; separate sewer at Eastbourne Terrace discharging on to the "Burrows." House drainage antiquated. Excrement disposal—mostly w.c.'s flushed in part from rain-water tanks; arrangements for flushing often in connection with drinking-water supply. Arrangements for refuse disposal in need of improvement, especially at Appledore. Slaughter-houses require attention. Byelaws out of date, and should be brought up to modern requirements. Regulation as to dairies, cowsheds, and milkshops, not enforced. Cowsheds mostly

in dirty condition. Infectious Disease (Prevention) Act, 1890, not adopted. Duties indifferently performed by Medical Officer of Health, whose reports are useless so far as setting forth the sanitary condition and needs of the district are concerned. No isolation hospital provision. The disinfection of infected premises indifferently performed or altogether neglected.

10. *NUNEATON AND CHILVERS COTON URBAN DISTRICT (WARWICKSHIRE); population (1891), 15,000; Dr. Johnstone.

Authority concerned: Nuneaton and Chilvers Coton Urban District Council.

Ground of Inquiry: Prevalence of enteric fever. Reports made by the Medical Officer of Health.

Chief Facts reported by Inspector: Enteric fever prevalent in the district during previous eight years. Epidemic prevalence from week ending August 5th, 1899, until week ending December 2nd, 1899. Localised mainly in Nuneaton town. During 1899 there were 114 cases with 16 deaths. The disease was spread by pollution of soil, personal infection, and pollution of well water.

Isolation hospital a temporary building. Many cases not isolated. Disinfector not sufficiently used. Old and leaky sewers. Privies with middens ill-constructed and of excessive size.

11. PENNAL VILLAGE (MERIONETHSHIRE); population of parish (1891), 610; of village, about 300; Dr. Wheaton.

Authority concerned: Machynlleth Rural District Council.

Ground of Inquiry: Complaints to the Board by the Towyn and Pennal School Board of the continued closing of their schools at Pennal an account of diphtheria; also from the Towyn Urban District Council as to the sanitary condition of Pennal village.

Chief Facts reported by Inspector: The schools at Pennal closed, at the instance of the Medical Officer of Health of the Towyn Urban District, from November 14th, 1899, to January 2nd, 1900, and from February 8th, 1900, to date of visit on May 21st, 1900, on account of diphtheria prevalence in the village. The schools are situate in Towyn Urban District, but the village in the Machynlleth Rural District.

Seven attacks of diphtheria in Pennal village since August 29th, 1899, up to date of visit, and five in outlying hamlets in Towyn parish, situate in the vicinity of

Pennal, with a total of four deaths. No general prevalence of throat affections in the village. The diphtheria appears to have originated under conditions of great sanitary neglect. The general condition of the village of Pennal is very unwholesome. Dwellings in the village are damp, small, imperfectly lighted and ventilated. Excrement disposal effected by cesspit privies, often placed close to dwellings, and very infrequently emptied. A few pail privies of unsatisfactory construction. No drainage; liquid refuse thrown on the ground or into surface channels. No public water supply situate at a convenient distance from the greater number of the dwellings. Water from springs and field drainage obtained from spouts and dip-wells. No isolation accommodation for infectious illness; no disinfecting apparatus.

12. PONTYPRIDD (GLAMORGANSHIRE); population, 38,900; Dr. Darra Mair.

Authority concerned: Pontypridd Urban District Council.

Ground of Inquiry: Fatal prevalence of diphtheria.

Chief Facts reported by Inspector: A mining district, thickly populated in low-lying portions, especially in the valleys of the Rhondda and Taff rivers. Along the former valley population directly continuous with that of the Rhondda Urban District.

Majority of dwellings are modern built, and well arranged in streets of adequate width. Back yards, for the most part, unpaved. Water supply derived from the Pontypridd Water Company; inadequate in summer. Most houses provided with water-closets and drained to sewers.

District practically free from diphtheria until 1897, when it appeared mainly in the Taff valley; the disease largely subsided in 1898, but reappeared in 1899, mainly in the Rhondda valley, and reached epidemic proportions in the third quarter. Prevalence continued up to time of Inspector's visit. During 1899, 227 cases notified; and in 1900, up to March 10th, 108 cases. Disease has been epidemic in Rhondda Urban District for some time past, and it appeared probable that it extended thence along the Rhondda valley.

No hospital isolation, and other preventive measures found to be deficient. The District Council were advised to cause house to house inquiries to be made, to adopt proper measures to prevent attendance at day or Sunday schools of children from infected houses, to make use of bacteriological aid in discovery of doubtful cases, and to provide the district with an isolation hospital with all speed.

13. Prestwich Urban District (Lancashire); population (1901) 12,839; Dr. Theodore Thomson.

Authorities concerned: Prestwich Urban District Council.

Ground of Inquiry: Undue prevalence of diphtheria in the district.

Chief Facts reported by Inspector: From January 1st to November 11th, 1900, 68 cases of diphtheria reported, and 10 deaths from diphtheria in the district. The disease, for the most part, restricted to one of four villages. Measures taken to prevent spread of the disease satisfactory. Circumstances of district unsatisfactory in some respects, especially as regards methods of disposal and removal of excrement and house-refuse.

14. Romney Marsh Rural District (Kent); population, 2,893; Dr. Darra Mair.

Authority concerned: Romney Marsh Rural District Council.

Ground of Inquiry: Refusal to appoint one Medical Officer of Health for the whole district.

Chief Facts reported by Inspector: Two Medical Officers of Health, in spite of repeated protests from the Board, since 1892. Allegation of Rural District Council that no medical man in district was willing to undertake whole district found to be untrue; either Medical Officer of Health expressed willingness to do so provided salary was somewhat higher than the combined salaries of the two appointments. Population very scattered over area of 29,565 acres; most populous village does not exceed 560 persons. No public water service; shallow wells almost universal; water brackish when obtained at a depth exceeding 12 feet. Almost complete absence of sewerage. Houses provided with privies, or, in some cases, earth closets and soakaway cesspools, which in many cases are near wells. Several instances observed of a sort indicating lack of inspection by sanitary officers. Medical Officers of Health do not make periodical reports, except annually, and seldom inspect their districts. They have been desired by District Council to do as little sanitary work as possible. A new Inspector of Nuisances has been appointed at salary of £10 per annum. At conference with District Council they were told that Board would not be likely to again sanction dual appointment, especially as it appeared that a medical man willing to take the whole district was available. They were also told that, apart from such problems as

public water service and sewerage, which might be impracticable in their case, it was evident that the district needed much sanitary inspection, which could not be obtained otherwise than by a reasonably-paid Medical Officer of Health acting in conjunction with a properly-paid and active Inspector of Nuisances.

15. *STROUD RURAL DISTRICT (GLOUCESTERSHIRE); population (estimated), 30,000; Dr. Mivart.

Authority concerned: Stroud Rural District Council

Ground of Inquiry: Continued prevalence of enteric fever. Memorial from Stroud Rural District Council complaining of injury done them by sewage discharged into streams by Nailsworth Urban District.

Chief Facts reported by Inspector: Working class dwellings damp and dilapidated. Public water service limited in area and insufficient. Local supplies from wells evidently contaminated, especially where sewage allowed to enter fissures in limestone. Sewerage very limited at present, though extension planned and impending. In some places sewage disposal of unwholesome kind; in others of highly dangerous character. Excrement disposal chiefly by discharge into streams or into limestone fissures; consequent gross pollution of streams and rivers by sewage matters as well as waste matters from factories of diverse kinds. Refuse disposal generally unsatisfactory. Slaughter-houses not registered. No registration of dairies, cowsheds, and milkshops; unwholesome conditions generally in all. Order of 1885 not enforced. No byelaws of any kind. The Infectious Disease (Notification) Act, 1889, adopted. The Infectious Disease (Prevention) Act, 1890, adopted; also Part III. of Public Health Acts Amendment Act, 1890, though no byelaws framed under latter. A temporary iron small-pox hospital. No disinfector. No infectious diseases hospital, and the proposal to erect one excites the most bitter and violent opposition.

No. 8.

REPORT on the GENERAL SANITARY CIRCUMSTANCES and ADMINISTRATION of the BOROUGH OF BOSTON; by DR. S. MONCKTON COPEMAN.

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On the General Sanitary Circumstances and Administration of the Borough of Boston; by Dr. Copeman.

Acting on instructions from the Board to make inquiry into the sanitary circumstances and administration of the borough of Boston, I visited the town in May and June, 1900. Every facility was afforded me in my work by the various officials concerned.

The sanitary condition of Boston, and the prevalence there of "fever," has been brought to the notice of the Board from time to time for a number of years past. In 1893, during the progress of the Cholera Survey, Dr. Bulstrode, one of the Board's medical inspectors, reported unfavourably on the arrangements for sewerage and drainage, refuse removal, and water-supply. He also called attention to the fact that such byelaws as were in force at the time were insufficient for the requirements of the town. As the outcome of Dr. Bulstrode's inquiry, a series of recommendations was made by the Board to the town council, but it appeared from annual reports of the present medical officer of health and his predecessor that comparatively little progress had been made, and, in consequence, the Board ordered further investigation.

The town of Boston is situated on low-lying land on either bank of the river Witham, which is tidal up to the Grand Sluice, towards the northern extremity of the town.

The geological formation on which the town is built consists of alluvium for an average depth of rather more than 20 feet, beneath which Boulder clay is met with. This, again, at a depth of about 150 feet, is underlain by Kimmeridge or Oxford clay.

Boston is the market centre of an agricultural district, and most of its industries are connected with agriculture. It is, moreover, a port of some magnitude, and since the docks have been built the fishing industry has been much developed, steam trawlers now bringing their cargoes of fish direct to the docks.

The population of Boston at the time of the census of 1891 was 14,570, but it is now estimated at rather more than 16,000. The borough has a rateable value of £47,240, and an assessable value of £45,673. The area at present comprised in the borough is 2,688 acres, and there are, according to the surveyor (Mr. Wheeler), 9¾ miles of dedicated roads, or 12½ miles if courts and narrow streets be included. The roads are laid either with granite blocks or with cobble stones, over which, throughout the greater portion of the town, a thin layer of asphalte concrete has been recently put down.

The number of new houses erected during the past five years is, according to the surveyor, about 235. There is supposed to be

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was made by the Clinical Research Association, at the instance of the medical officer of health. The particular sample of water reported on had apparently been forwarded as long previously as August 26th, 1899, but no reason is given in the report for the extraordinary delay in forwarding a statement of the results obtained. The total number of micro-organisms found per c.c. is stated to be higher than on a former occasion, and the *Bacillus coli* was isolated when comparatively large quantities of water were examined. The report suggests that the ordinary water organisms had, owing to the hot weather prevailing at that time, multiplied considerably while the sample was in transit, and the conclusion is that there is no evidence of sewage contamination occurring in such quantity as to warrant condemning the water supply. Apparently no chemical analysis was made.

Occasionally, and, as I was informed, more particularly in hot weather, complaints are received that the water drawn from taps in the town is somewhat discoloured, and deposits a sediment on standing. This is due to the fact that the water, when of a comparatively high temperature, is capable of exerting increased action on the iron of which the mains are composed, during its passage through the miles of pipes intervening between the waterworks and the town. Though unpleasant to the eye, the periodical occurrence of this discoloration does not, in all probability, indicate any dangerous contamination of the water. Moreover, the condition of which complaint is made can often be obviated in large measure by not using the water first drawn from the house-taps in the morning. Owing, it would seem, to the water mains having been laid for the most part only some 2½ feet beneath the surface, the temperature of the water usually exceeds 60° F. from about the middle of July to the middle of September; occasionally during this period it may reach as high a point as 67° F.

From what has been said, it will be apparent that although the quality of the company's water has shown distinct improvement of late, the result probably in large measure of better filtration, yet there is obviously room for further improvement. The present manager of the waterworks appears to be an energetic and capable official, who keeps himself informed as to the progress of knowledge, both mechanical and biological, in connection with his special work. It is to be hoped, therefore, that the water company, with the assistance of their manager, will be successful in their endeavours to secure that the water supplied by them shall eventually reach a high standard of purity.

SEWERAGE AND DRAINAGE.

The town of Boston is divided into two portions, east and west, by the tidal river Witham. The considerable rise and fall of this river, more particularly at certain tides, is utilised in the periodical flushing-out of a portion of the main sewerage system in a manner presently to be described.

East Boston Sewerage. The Barditch:—East of the river, the sewage of the more central and oldest part of the town discharges

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to an ancient sewer called the Barditch. This was originally uncovered from end to end, but it has gradually become covered in by the owners of the property through which it passed, so as to enable buildings to be erected over it. This having been done on no definite system the dimensions of this sewer vary considerably at different parts of its course, while, for the most part, the bottom is very uneven, and the sewer has no regular fall. At intervals along its course are large catch-pits, the periodical emptying of which is not only a matter of considerable expense, but often of much annoyance to persons living in the neighbourhood. This sewer is under the control of a body termed the Court of Commissioners of Sewers; the sanitary authority of the borough, curiously enough, having, as such, no voice in its management, although members of the town council are *ex officio* members of this court. On an official of this court, known as the Dykereeve, devolves the responsibility for the condition of the dykes and sewers under their charge.

The Barditch, as will be seen from the annexed map, commences at St. John's Gowt near the ferry at the end of the Skirbeck Road, and passing at the back of the Grammar School, the end of Spain Lane, through the Peacock Yard across Dolphin Lane, under the Corn Exchange, across Straight Bargate, through the Red Lion Yard, under the houses at the corner of Chapel Street, then by Laughton's School, empties at Dipple Gowt near the Grand Sluice. Taking roughly the form of a crescent, this sewer extends for about three-quarters of a mile from its commencement at the river side below the town to its termination where it enters the river above the town, the sill of the sewer outfall being about 10 feet below that at its head. Thus the whole of the sewage discharged into the Barditch passes from south to north, and is discharged into the river at a point just below the Grand Sluice, whence it has to flow back along the river throughout the whole length of the town, passing in its course all the houses and other buildings on the river bank.

The head of water in the river at high tides is utilised for the flushing of a portion of the Barditch, the possibility of obtaining this periodical flushing having apparently been the reason for arranging that the flow of sewage should take place in the reverse direction to that which would appear most desirable. Three systems of sluice gates have been laid down, one at the head of the sewer, protected by a stout iron grating to prevent the entrance of solid floating bodies, a second at a point where the ditch passes close to the market place, and a third about 50 yards distant from its outfall. I was informed by the Dykereeve that on an average the water in the river was sufficiently high to be turned into the head of the sewer nine times a fortnight, though it would appear that actual flushing of the Barditch is not carried out as frequently as this. The method of performing the operation is to close the market place sluice, and open that at the sewer head, by which the upper portion of the sewer, forming roughly about half its length, is more or less filled with the river water. When such an amount of water as is considered sufficient has been admitted, the sluice at the sewer head is closed. The water that has been taken

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in, together with the contents of the sewer, is of necessity now held up until on the ebb the river has fallen sufficiently to render discharge from the outfall of the Barditch possible. The tide having fallen sufficiently, the two lower sluices are opened, when the lower half of the sewer is flushed out by the discharge of the water which had previously been penned up above the middle sluice. From the description given, it will be seen that for a considerable portion of each twelve hours the contents of the Barditch remains stagnant, and, as during these periods it is nevertheless receiving continuous additions of sewage matter through the contributory drains which join it at frequent points throughout its course, the pressure within it must be considerable at times, more especially as throughout its whole length no provision has been made for ventilation. The southern portion of the Barditch, which has been covered in comparatively recently, is in section an oval, the internal dimensions of which are much smaller than that of other and northern portions. At the point where I examined this egg-shaped sewer the quantity of fluid contents was small and very little deposit was to be seen. At points further north the dimensions of the Barditch became so great as easily to permit of a man standing upright in it, and the amount of deposit was greater. As the Barditch is unventilated, the smell when the manholes were unsealed was foul, particularly when the sluice at the sewer head was opened.

Maud Foster (*Bargate*) *Drain* :—The sewage from the east side of the town not drained by the Barditch passes for the most part by a large number of comparatively small drains discharging into the Maud Foster, or, as it is otherwise called, the Bargate Drain (*see* map). This so-called drain is one of the wide canals or channels which were originally cut for the purpose of draining the Lincolnshire Fenlands. Its course is almost directly from north to south, dividing Boston on its western side from the rural district of Skirbeck on its eastern bank. South of the town, and just beyond the Boston docks, it opens into the tidal portion of the river Witham. At this point are sluice gates, by which the water in the Bargate Drain is held up, often for long periods at a time, for the benefit of the farmers in the uplands during periods of scanty rainfall.

The greater number of the houses along the Skirbeck side of the drain also discharge into it, and thus, during hot weather, the stagnant water of the drain becomes exceedingly offensive. In a report by Mr. W. H. Wheeler, the present surveyor to the borough, dated August 30th, 1866, he states that "the total number of houses draining into Maud Foster on the Boston side is 839, in addition to the union workhouse and several slaughter-houses and factories. . . . . The total quantity of sewage matter daily discharged by Boston alone into Maud Foster Drain cannot be less than 83,900 gallons; and, as in a dry summer, no upland water finds its way down the drain, the water in it is stagnant during the hottest months of the year." The total number of houses whence sewage reaches the Maud Foster Drain, has, during the last 30 years increased largely, and the daily volume of sewage has been correspondingly augmented. Of the drains discharging

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into the Maud Foster from the Boston side, a few, as in the case of the Barditch, are under the control of the Court of Commissioners of Sewers. This circumstance has made the question of dealing with the pollution of the Maud Foster Drain somewhat complicated, but a much more important obstacle to amending the condition of this drain arises from the fact that joint action on the part of both Boston and Skirbeck is necessary if any useful result is to be obtained. For the past 40 years at least, from time to time, attempts have been made to deal with the problem, now by the urban, and now by the rural sanitary authority. But the two have never united in formulating and executing an adequate sewerage scheme, and their several plans for individual action have time after time proved abortive.

There can be no doubt that a satisfactory system of sewerage, independent of the Bargate Drain, is as much needed for that part of Skirbeck adjoining Boston as for East Boston itself.

At present, setting aside those Skirbeck dwellings which are close by the Bargate Drain, the great majority of the Skirbeck houses drain into "soakage wells," that is, cesspools, the interior of which is purposely constructed so as to allow the material discharged into them to soak away as freely as possible into the neighbouring sub-soil.

Two special instances of nuisance due to defective arrangements for the drainage of houses in particular areas of Skirbeck, in the vicinity of Boston, came to my notice. On the left-hand side of Hospital Lane, as one goes from Boston, a drain, serving several houses, terminates by the edge of the footpath in a two foot barrel-drain which empties into an open ditch. This latter, which passes along two sides of a large field, used formerly to discharge into the Bargate Drain, but the exit door having become damaged, the Commissioners of Sewers, it would appear, instead of repairing the door, bricked it up and put in a small sanitary pipe elbow, so spoiling the fall. This ditch is cleared out occasionally, nevertheless, at the time of my visit, semi-solid material, the smell from which was very offensive, filled the ditch to within six inches of the crown of the barrel-drain. In Old Workhouse Lane I found a similar condition of affairs, the only difference being that, as far as I could learn, this ditch has always been practically an open cesspool.

In November, 1898, an enquiry was held at Boston by an inspector of the Board, with reference to a representation made by the town council as to the desirability of including within the borough the outlying districts of Skirbeck and Skirbeck Quarter, together with a portion of the parish of Fishtoft. It was urged on behalf of the borough, that Boston itself and the populous parts of Skirbeck and Skirbeck Quarter form one continuous town, and that the urban parts of these parishes are outgrowths of the borough. Against the representation it was urged, however, among other points, that as the sewerage of the borough is very deficient the areas proposed to be added would gain nothing with respect to sewerage, and that in consequence, even if it were desirable that the borough should be extended, no extension

should be authorised until the corporation are in a position to offer good and efficient means of sewerage to the districts which they wish to annex. The Board refused the application.

As far as I could learn, the town council now appear to take up the position that until incorporation of Skirbeck with Boston is effected it is impossible for them to move in the matter of improvement of the Bargate Drain, as the Boston Rural Council, in whose district Skirbeck is situated, would be unwilling to share the necessary expense of diverting all sewerage from this water-course.

West Boston Sewerage.—On the western side of the town the system of sewerage, which has existed since 1858, or earlier, appears very inefficient. In certain respects it even compares unfavourably with the condition of the Barditch on the east side of the town.

In Boston West the difficulties encountered when the present system of sewers was laid down were undoubtedly considerable, since the gradients are of necessity very flat. The main sewer had to be arranged to discharge at low water, and as the whole surface of the town through which it passes is below high-water level, the gradient of the sewer throughout its length of more than a mile does not exceed one foot in every thousand feet.

This main sewer commences in Carlton Road, passing thence along Fydell Street and Irby Street, and onwards as far as King Street, from which point it passes through private property to an outfall into the haven near the basin in Skirbeck Quarter. Extensions of this sewer have been carried down Argyle Street, Granville Street, Sydney Street, and Sleaford Road. The sewer where of brickwork is egg-shaped, radiated bricks, specially made for the purpose, having been used. The invert is made of earthenware. Tributary sewers are formed of glazed stoneware pipes, the joints caulked with hemp and cemented. At irregular intervals along the course of the sewer are manholes with iron covers, some of which are perforated. Beneath each manhole the floor of the sewer is deepened to form a catch-pit for solid matter, which, as I was informed, is cleared out "from time to time." No ventilating shafts have been erected along the course of the sewer, as the surveyor has advised the sanitary committee that they enable the effluvia to escape "more on a level with the bedroom windows of houses," adding, in a report to the committee, that he had found it impossible to obtain suitable sites for their erection. Recently manhole covers have been made air-tight, and sewer air, especially when under pressure, through the outfall being blocked, is likely to escape into the houses. So likely is this to happen that the sanitary committee now suggest that it would be better to "re-open the manholes, and endure the occasional smell arising from them, than run the risk of sewer gas escaping into houses through improperly trapped drains."

Certain of the houses on the western side of the river, for instance in High Street, Stanbow Lane, part of Pinfold Lane, and St. George's Lane, do not drain into the main sewer, but

discharge direct into the haven. Another portion of the town, in the area including Woodville Road and Brothertoft Road, is so low-lying that it has been found impossible to drain the houses into any of the branch sewers. In consequence, cesspools have been provided, in some instances too near the houses, which have purposely been left uncemented, in order to allow the liquid portion of their contents to soak away. Owing, however, to the impervious nature of the ground, the result desired has not been obtained, and one or two that I examined were full, almost to the level of the ground, with foul-smelling contents, the surface of which was covered with large gas bubbles. One of the occupiers complained that, owing to the pressure in the cesspool, his house-traps had been forced, with results decidedly unpleasant and possibly dangerous. A few houses near Woodville Road drain into a ditch, which passes, for some distance, alongside the road, and eventually discharges into the North Forty-foot Drain.

Emanations from this Woodville Road ditch cause considerable nuisance in summer.

Flushing of the western sewer is effected by tanks constructed at "the principal terminations of the sewers in connection with it (*see* map). The tanks hold from 600 to 1,000 gallons each, and are supplied from the water company's mains. As soon as the water reaches a certain level in the tank it is discharged into the sewer by a syphon specially designed for the purpose. The time occupied in filling the tanks varies according to the size of the supply pipe in the street, from a quarter of an hour to two hours, and to discharge from one to two minutes. The water company charge £2 a year for the water for each tank, reserving the right to stop the supply in case of scarcity of water. Each tank is used twice a week."* The flushing tank at the head of the sewer which passes down Sleaford Road was, at the date of my visit, opened and the cover of the manhole nearest below it was also removed. As a result, a most objectionable smell asserted itself, making my inspection of the interior somewhat difficult. The catch-pit at the bottom of this manhole was full of semi-solid matter, which extended into and half filled the sewer itself. On the discharge of the contents of the flushing tank no appreciable disturbance of this semi-solid deposit had occurred after an interval of ten minutes, when observation was discontinued. The flushing tank in Sydney Street was said to be out of order. In Carlton Street an experiment in flushing on a gigantic scale, independently of the flushing tanks, had just been carried out under the supervision of the surveyor. Water from large clay-pits had been pumped by steam power for a fortnight into the sewer at a manhole where, by blocking up one or other of the sewer openings the water could be made to pass along either to the right or left, the sewer being practically level at this point. As the result of the influx of so large a quantity of water (at a cost, as the surveyor informed me, of about £20) this sewer was free from deposit between the manhole and the junction of the sewer with the one in Sleaford Road.

* Report of Surveyor, 1894.

Manhole covers were, on the occasion of my visit, also removed in Granville Street and Irby Street. In the former sewer I found the accumulation of stagnant sewage so considerable that it was impossible to see either the inlet or outlet of the sewer. The surface of the sewage was covered with bubbles and the smell was most offensive. In Irby Street also I found the manhole full of stagnant sewage to within about a foot of the road surface, although, at the time, the tide in the haven was quite low. In short, the greater portion of the sewerage system on the west side of the town has come to constitute what is practically a gigantic cesspool, the contents of which, under existing circumstances, are never completely removed, and consequently undergo putrefactive changes *in situ*, the gases resulting from these processes finding an exit as best they can, either through or around the manhole covers or to the interior of houses.

Evidence that the sewers leak in places is afforded from time to time when the roadway is opened up for any purpose near the main sewer or one of its branches. This was particularly evident early in the present year when the ground in Granville Street was opened for the purpose of laying water-pipes. In this particular street the sewer, as I am informed, always stands full or nearly so. On this account house drains discharging to this sewer have been so laid as to enter the sewer at the top, instead of at the side as would be the case under ordinary circumstances.

House drains for the most part consist of earthenware pipes which are disconnected from the house by means of gulley traps over which sink and other pipes discharge. In the great majority of cases no provision is made for their ventilation.

Excrement and Refuse Disposal.

Water-closets, with flushing apparatus proper, are comparatively few in number in Boston. There exist, however, some 150 closets unprovided with any proper water supply for flushing purposes, the reason given being that the charges of the water company for the installation of a cistern and its accessories, and for the use of water for closet flushing, are prohibitive. These "hand-flushed" closets are commonly very foul.

With the above exceptions, "ash-bin" closets are almost universal in Boston. The type of those closets approved by the town council consists of a combination of privy and ash-bin. The vault, usually about three feet square and rather less in depth, is required to be built above the level of the ground and to be made water-tight, and a drain is connected with the lowest part of the vault in order to carry off any excess of liquid beyond what can be absorbed by the ashes. The contents of the vaults are supposed to be emptied by men employed by the town council once every fortnight in winter and once a week in summer, but in the hot weather the operation is liable to be specially offensive, particularly as in summer time the supply of ashes is apt to become very scanty. With the idea of minimising offence incidental to the emptying of the vaults, carbolised peat is now employed as a

deodorant, a fact which may account for farmers being no longer willing to take over the excremental material removed, the presence of carbolic acid being perhaps held to diminish its manurial value.

In the ash-closets on certain premises the vaults were full up to, or even above, the level of the seat; in other instances, the vaults contained a considerable quantity of fluid. It is thus apparent that arrangements for removal of the privy contents are inadequate. In one or two instances I found that, owing to there being no means of access from the back, the only way of removing the contents of the privy-vault was through the living rooms of cottages.

Collection and disposal of refuse from these closets is a task of considerable magnitude. The quantity of material collected amounts, according to the surveyor's estimate, to about 14 one-horse loads daily, or an average of from 4,200 to 4,300 per annum. Formerly, the material collected was in considerable demand with farmers and market gardeners in the neighbourhood, and the refuse was readily disposed of at a price of from 2*s*. to 2*s*. 6*d*. per load, delivered free. Of late, however, the demand has fallen off to such an extent that difficulty is now experienced in getting rid of it at any price.

At present, the material, consisting of fæcal material mingled with a certain proportion of ashes, together with potato peelings and other household refuse, such as old tins, boots, paper, &c., is carted outside the town, for distances varying from one to two miles, and tipped into disused brick pits. Concerning these dumping grounds, the medical officer of health says in his annual report for 1899:—"An intolerable nuisance is created in almost every outskirt of the town by the accumulation of huge heaps of refuse and garbage, deposited by the sanitary authority and allowed . . . . . to remain for months, pouring out the most sickening smells. During the summer and autumn, many houses are almost uninhabitable, being invaded by myriads of flies, which are bred upon these putrid heaps of filth."

I visited certain of these collections of refuse which lie alongside the main road which runs near to the White Bridges in Skirbeck Quarter about a mile from the town, and I can fully confirm the description of the medical officer of health as to the grave nuisance arising from these deposits. I found a block of cottages within about fifty yards of the spot on which, at the time, the contents of a refuse cart were being tipped; the inhabitants of these cottages make much complaint of the smell arising, more particularly in summer, from the refuse heaps. In this and in some other cases a large quantity of water was present at the time that the filling-in process was commenced, and no attempt has been made, either at that time or since, to drain the site. As a consequence, putrefaction is accelerated and nuisance increased.

Locally it is considered that eventually dwellings may be erected on ground made level by the filling-in of these pits with refuse.

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To secure abatement of the nuisance from the present method of disposal of the town's refuse, the medical officer of health recently suggested to the sanitary committee the advisability of erecting a destructor. The committee have expressed the opinion that difficulty would arise from a destructor having to be placed some distance away from the town, and that in whatever spot it were placed a very great nuisance would be created by the succession of carts delivering refuse to it, and they say that they have not succeeded in finding any place where they think a destructor could be used without being objected to by the surrounding inhabitants. I ascertained that the surveyor was aware of no less than six possible sites, of which one appeared to possess certain special advantages, in that it is situated in the lowest part of the west side of the town (*see* map), and so would make a convenient site for a pumping station for lifting the sewage from the district where the drainage at the present time is most defective. Power for pumping sewage, or for generating electricity, could be rendered available by the consumption of the refuse.

The surveyor estimates the cost of a sufficient two-cell destructor, together with the cost of land on which to erect it, as about £2,000. Putting the annual cost of labour and repairs in working the destructor, after allowing for sale of clinkers, at an average amount of 1*s.* 3*d.* per ton, and taking the quantity to be destroyed at the present time as 15 loads a day, or 12 tons, he reckoned the annual cost at £232 10*s.*, or, with an additional £100 for interest and repayment of capital on an outlay of £2,000, to a total of £332 10*s.* He points out that the cost of scavenging, including street sweeping and collecting house refuse, is annually increasing, the sum paid during the past year having been £1,167, while the sale of a portion of the material for manure only realised £108. The net cost in 1899 was therefore £1,059, as against £923, the average net cost of the past three years. The great expense thus incurred is in part due, he considers, to the fact that the material has often to be carted for considerable distances, which, again, will account for the small quantity collected by each cart.

OTHER SANITARY CONDITIONS.

There are *six common lodging-houses*, which are all registered Their condition leaves much to be desired; the cubic space allowed per head is insufficient, and the sanitary arrangements are generally bad. In one instance the closets, situated in a narrow yard behind the houses, were in an extremely filthy condition.

Thirty slaughter-houses are registered, of which 26 are in regular use. Of these 26, some appear to be kept clean, but many are not. The regulation as to hanging up a copy of the byelaws is not always complied with. At a slaughter-house in Threadneedle Street the floor had not been washed down after slaughtering on the previous evening; there was a large accumulation of manure in the yard; the drain was stopped, and

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irregularities in the yard were filled with stinking fluid material. In another slaughter-house a receptacle filled with garbage, and a bucket of blood, had been left over from the previous day; and on several other premises I found great want of cleanliness.

The keeping of pigs on slaughter-house premises is common. Much complaint it occasioned, but the practice cannot be dealt with, in the opinion of the town clerk, under the present byelaws.

It would undoubtedly prove advantageous, not only to the inhabitants, but also to the butchers, if a public abattoir could be substituted for the many small private slaughter-houses at present existing.

The Dairies, Cowsheds, and Milkshops Order having been disregarded by the town council, no regulations are in force for insuring that the milk-supply shall, as far as possible, be kept free from contamination of one or another kind. There are twenty-eight cowsheds in the borough, in which at the time of my visit 107 cows were housed. The condition of many of these cowsheds, as regards provision of air space and ventilation, is unsatisfactory.

Of the *bakehouses* some were as clean and well-arranged as others were the reverse. At a bakehouse in Wormgate, not only were the premises exceedingly dirty, but a quantity of bones and tattered bits of clothing were littered about. Another Wormgate bakery had a "hand-flushed" water-closet built against the bakehouse wall, the doors of bakehouse and closet being sufficiently close to allow an unpleasant smell to pervade the bakehouse.

Offensive trades carried on at Boston are those of fell-mongering and tallow-boiling. No byelaws for minimising nuisance from the processes incidental to these trades have been adopted, though formal complaint seems to have been made to the town council on more than one occasion.

ENTERIC FEVER AND DIARRHŒA IN BOSTON.

Enteric fever:—During the past ten years there have been only two during which not a single death has been recorded from enteric (typhoid) fever, while in three of these ten years the number of deaths has, considering the population of the borough, been excessive.

In his annual reports for 1898 and 1899, Dr. Tuxford, the medical officer of health, has directed special attention to the question of the increased incidence of enteric fever in these two years. Dr. Tuxford further noted that in 1898 the cases were nearly three times as numerous on the west as on the east side of the town, and concluded that the prevalence of the disease must bear relation to the inefficient sewerage arrangements, and the consequent fouling of the soil. In 1899 the distribution of enteric fever cases was more general than in the previous year, 18

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out of 30 notified cases of the disease having occurred on the west side of the town, and 12 on the east, or, if cases of "continued fever" be added, the numbers will be 19 for the west side and 15 for the east respectively.

The sanitary committee of the town council are responsible for a recent statement that "It is during the last two years that the number of typhoid cases has been at all serious," adding, on what grounds I do not know, "We do not think that any fresh system of town drainage would lessen the sickness or make the town more healthy." From the first of these statements it would appear that the writers were ignorant of the fact that in 1893 Boston was visited by an outbreak of enteric fever more widespread than was the case in either 1898 or 1899.

In the following year, 1894, there were no deaths from enteric fever, but from that date onwards the disease has tended to increase. The following table gives the number of notifications and of deaths during the past ten years :—

Enteric Fever in Boston.

Year.	Notifications.	Deaths.
1890	1	1
1891	9	3
1892	3	—
1893	97	12
1894	4	—
1895	12	1
1896	11	4
1897	24	4
1898	30	6
1899	30	8

Diarrhœa annually accounts for a considerable number of deaths in Boston, more particularly among infants under one year of age. For several years past the medical officer of health has called attention in his annual reports to the excessive infant mortality in the borough, and in 1899 he notes that the infant death rate reached 221·98 per 1,000 births, no less than 103 deaths out of a total of 340 deaths from all causes having been in children less than one year old. Of these 103 deaths, 20, or nearly one-fifth of the total number, were from diarrhœa. In 1898 there were 12 deaths from this disease, and in 1897 no less than 35.

The following table gives the number of deaths from diarrhœa in children under one year old for the past five years :—

Deaths from Diarrhœa in Children under One Year.

Year.	Deaths per Month.		Total for Year.
1895	August	1	5
	September ...	4	
1896	February ...	1	5
	August	3	
	September ...	1	
1897	July	1	35
	August	24	
	September ...	9	
	October	1	
1898	September ...	9	12
	October	2	
	December ...	1	
1899	July	3	20
	August	9	
	September ...	6	
	October	1	
	November ...	1	

From the table it will be seen that the greatest number of diarrhœa deaths occurs in the autumn months. This special incidence in late summer or autumn is a characteristic of the disease, probably due, as is suggested by the researches of the late Dr. Ballard, to the circumstance that a specific diarrhœa microbe is ordinarily an inhabitant of the soil, and that it is only when the soil temperature at some distance below the surface reaches a sufficiently high point that the micro-organism is awakened into exceptional activity.

In discussing the question of the sewerage and drainage arrangements in Boston, I have shown that the sub-soil can hardly fail to be seriously contaminated. Thus are brought about conditions to be regarded as especially favourable to epidemic and infantile diarrhœa.

Here it may be added, as regards prevalence of enteric fever, that it seems perhaps permissible, having regard to the inquiries of the medical officer of health, to exclude the agency of water or milk as factors in its increased prevalence during recent years. Accordingly, while allowing for the probability that personal contagion from diseased to healthy persons may, on occasion, have played some part in the matter, there is ground, in the light of our present knowledge of the etiology of enteric fever, for suspecting that here again contamination of the sub-soil may have been concerned.

SANITARY ADMINISTRATION.

The sanitary committee of the town council consists of nine members, who meet fortnightly. Mr. Wm. Pooles, the present mayor of the borough, and by profession a solicitor's clerk in the employ of Mr. Staniland, the town clerk, is chairman of the committee.

The medical officer of health, Arthur Tuxford, M.D., holds a similar post in the Boston Port, Boston Rural, and Sibsey Rural Districts. He also acts as medical superintendent to the Boston Fever Hospital. Dr. Tuxford is also in private practice, is physician to the Boston Hospital, and has recently been appointed to the post of coroner. He is an energetic official and appears to have a fair knowledge of the local sanitary circumstances of the districts under his charge and of his duties in connection therewith. In the Boston Urban District he is, however, ill-supported by his authority. That this is so has recently been exemplified by the action which the sanitary committee of the town council have taken in making a determined attempt to refute certain statements made by Dr. Tuxford in his annual report for 1899, as to conditions prevailing in the borough of Boston, which, quite properly, he stated to be prejudicial to the health of the town. Dr. Tuxford's salary as medical officer of health for the Boston Urban District is £65, half of which is repaid from county funds.

The inspector of nuisances, Mr. John Stephenson, holds a similar post under the Boston Port Sanitary Authority, and the Boston Rural District Council. He is also inspector of canal boats. He is by profession a surveyor, but he possesses no definite qualification as inspector of nuisances. Nevertheless, he is an able and energetic official, with intimate knowledge of the sanitary circumstances of his district and of his various duties in connection therewith. As inspector of nuisances for the urban district, he receives a salary of £74 14*s*. per annum, half of which is repaid from county funds.

The following adoptive Acts are now in force in the borough of Boston,* the date in each case being that on which the Act came into operation :—

February 13th, 1878.—The Baths and Wash-houses Acts.

January 1st, 1890.—The Infectious Diseases (Notification) Act, 1889.

May 1st, 1891.—The Infectious Diseases (Prevention) Act, 1890.

March 1st, 1891.—The Public Health Acts Amendment Act, 1890. Part III.

March 1st, 1893.—The Private Street Works Act, 1892.

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* The port sanitary authority have not adopted either the Infectious Diseases (Notification) Act, 1889, or the Infectious Diseases (Prevention) Act, 1890, neither do they possess any regulations under section 125 of the Public Health Act, 1875.

The byelaws in force in the urban district were confirmed by the Home Secretary on December 12th, 1867. These have reference to the following subjects :—

Scavenging.
Nuisances.
Common Lodging-houses.
New Streets and Dwellings.
Markets.
Slaughter-houses.

Although the corporation own some good baths, now underlet, no byelaws are in force as regards public baths and wash-houses.

The question of byelaws having been referred to by the medical officer of health, in his annual report for 1899, the sanitary committee, in their published criticism of that report, say :— "Your committee have considered sometime since the advisability of fresh byelaws. The present ones are old, but the surveyor advises the committee that they are sufficient." . . . . In another section of this same report the committee say, in reference to the question of certain sanitary defects in houses to which the medical officer of health had called attention :—"No certificate of completion had been given by the surveyor," intimating that the medical officer had been unduly hasty in reporting on the matter, since a byelaw exists to the effect that no new dwelling shall be occupied until the surveyor shall have given a certificate that all the sanitary and other arrangements have been carried out in accordance with regulation. Being desirous to obtain evidence as to the manner in which the present byelaws, considered by the committee, on the authority of the surveyor, to be sufficient for all purposes, are enforced, I took as a test case this question of building certificates, and applied to the surveyor to show me the counterfoils of such certificates as had been issued during the past five years. During this period about 235 new houses, as he informed me, have been erected in Boston, but except in a single instance no "certificate of completion" had, I found, been issued by him during this same period. The exception occurred in the month of May, 1900, when a certificate was issued in reference to a house now in the occupation of the son of the medical officer of health. Only seven certificates had been issued during the last thirty years, yet a considerable penalty (£5 and £2 per diem during default) is supposed to be inflicted on persons occupying a house in respect of which such a certificate has not been issued. In this connection, also, it is of interest to learn that the committee in their own words "have never yet had before them a case in which the present byelaws have not been sufficient to enforce any liability they have thought necessary." The town clerk was only able to tell me of a single instance in which a penalty had been inflicted for contravention of the building byelaws.

Isolation Hospital.

In 1881 an old farm house, situated about one-and-a-quarter miles from Boston, and about a quarter-of-a-mile from the docks

and landing stage, was acquired as an isolation hospital, for the joint use of the urban, rural, and port sanitary authorities. It contains four rooms intended for use as wards a bedroom for the caretaker and his wife, and a large and airy kitchen, which is also used as a living room. The hospital, although well isolated from other buildings, is too near the public roads. On the same site there is in addition a small brick building erected in 1893, which is known as the small-pox hospital. This building is damp. It has no furniture and there is no closet accommodation. Attached to the farmhouse building are a couple of ash closets which I found in a filthy condition. There is a building which does duty for a laundry, and several out-houses, one of which contains an old and clumsy ambulance; but this is shortly to be replaced by a more modern and convenient conveyance. There is no mortuary. Rain-water is stored in an underground tank and pumped up for use in the hospital. The caretaker informed me that it is usually very dirty, and has an exceedingly unpleasant taste. For drinking it is now always filtered through a Berkefeld filter. Slop-water passes to a cesspool, which is emptied occasionally.

A labourer and his wife live on the premises as caretakers, for which they are paid £30 per annum. When there are patients in the hospital the man is paid an extra 15*s*. per week, and the woman is paid 3*s*. a week for each patient up to a limit of 12*s*. for acting as nurse. She has not had any hospital training. Hitherto, the various authorities concerned have not provided a trained nurse, although private practitioners who are allowed to attend their own patients in the hospital have, on occasion, installed an efficient nurse in charge of such cases. This arrangement has been productive of friction, owing to the respective duties of the nurse and the caretaker's wife in such instances not having been accurately defined.

Disinfection.—Neither urban, port, nor rural authorities possess an apparatus for disinfection, although the provision of an efficient apparatus for this purpose was strongly recommended both by Dr. Bulstrode and by myself at the time of our visits of inspection to the urban and port districts respectively, during the cholera survey of 1893.

In answer to an enquiry from this Board in April, 1894, as to what steps the Boston Urban Sanitary Authority proposed to take in reference to the recommendations of their inspector, the town clerk stated, that as regards disinfection, no difficulty had been experienced in disinfecting articles or clothing. The providing an efficient "portable disinfector has been recommended by the medical officer, and will be considered by the joint authorities." Apparently the joint authorities determined to leave the matter *in statu quo*, as nothing further has been done, notwithstanding the recommendations from this Board and from their own medical officer of health.

Premises which have been occupied by patients suffering from infectious disorders are fumigated with sulphurous acid gas, under the direction of the inspector of nuisances, on the termination of

the illness. On occasion, infected clothing has been destroyed by burning. At the isolation hospital infected bedding and body linen, &c., is soaked in a disinfectant solution and subsequently boiled.

Recommendations.

1. The town council should at once carry out a comprehensive scheme for the efficient sewering of the town.

2. The town council, pending the general adoption of water-closets, should adopt an improved system for the disposal of excrement and other refuse.

3. More extensive provision than at present exists should be made for the isolation of cases of infectious disease, in view of the fact that the farmhouse, which now serves as the isolation hospital, in addition to having to meet the demands made upon it by the urban sanitary district, has further to provide for the wants of a population of about 25,000 in the rural sanitary district, and an unknown number from the shipping of the port. The present administrative arrangements should be improved, and mortuary accommodation should be provided at the hospital.

4. The town council should, as speedily as possible, provide an efficient apparatus for the disinfection of infected articles and clothing.

5. The town council should, under the advice and with the assistance of their medical officer of health, revise and extend the existing byelaws, and bring them, so far as the special circumstances of the district permit, into accordance with the model series issued by the Local Government Board.

6. The town council should draw up and submit to the Local Government Board regulations under the Dairies, Cowsheds, and Milkshops Order of 1885–1886, in accordance with the powers conferred upon them by Section 13 of that Order.

Addendum No. 1.

Laboratories,
12, Colville Road,
London, W.,
November 20th, 1897.

Dear Sir,

We enclose herewith the results of our analyses of the four samples of water taken at the Boston Waterworks and Town Supply by our assistant on the 9th inst. In addition to these four samples, which have been completely analysed chemically and bacteriologically, we took a fifth sample from the main, seven miles from the reservoir, for bacteriological examination.

The result of the bacteriological examinations are as follows:—

Number.	—	Microbes per c.c.
1	Unfiltered water from beck above the reservoir	1,660
2	Unfiltered water from near outlet of reservoir	440
3	Filtered water by outlet to main	81
4	Filtered water from stand-pipe in Boston Market	867
5	Filtered water from main 7 miles from reservoir	442

Bacillus coli communis was found in all these samples, but the typhoid bacillus, although specially searched for, was not found.

The chemical analyses show that the waters are of inferior quality; the organic carbon and nitrogen are very high, and the complete absence of nitrates and nitrites show that self-purification by oxidation is not taking place.

The efficiency of the filtration is only 81·6 per cent., as compared with the efficiency of over 99·9 per cent. usually obtained by the filter beds of the Metropolitan water companies.

We would especially urge on your company the great necessity of improving the filtering appliances so as to bring them up to the level of those of the London companies. Apart from the question of microbes and the excess of organic matter, which may be partly due to vegetable peaty matter, the water is of good quality chemically. But it is necessarily exposed to the dangers of contamination to which all surface waters are exposed, and on this account it requires additional care in filtering. The fact that *Bacillus coli communis* was found in all the waters points to a source of pollution which may at any moment become very serious

We remain,
Truly yours,
WILLIAM CROOKES.
JAMES DEWAR.

R. W. STANILAND, Esq.,
BOSTON, LINCOLNSHIRE.

ADDENDUM No. 2.

LABORATORIES,
14, COLVILLE ROAD,
LONDON, W.,
November 23rd, 1897.

DEAR SIR,

I beg leave to acknowledge receipt of your letter of the 22nd inst. So far as we are acquainted with the nature and extent of the filter beds at the works of your water company, it would seem possible to us, unless there is some engineering difficulty with which we are unacquainted, to almost immediately improve the quality of the water supply, and render it satisfactory for public use. We refer to the addition of a layer of sufficient thickness (from 4 to 6 inches) of fine selected sand on the surface of the present filtering layer. This would require to be done under the direction of a competent engineer of large

experience in this kind of work, like Mr. Bryan, of the East London Waterworks Company, who would then be able to say if the present area of filter beds, with such an addition, would be able to filter at the proper rate a sufficient quantity to supply the daily needs of Boston, or whether the filter beds would require to be extended.

It does not necessarily follow from the presence of *Bacillus coli* that there is any mixture of human sewage. It may be from animal pollution. At the same time, its presence in a drinking water should always be regarded with grave suspicion.

In the meantime, we see no objection in the water company acquiescing in the recommendation of the medical board of health that it would be safer either to boil the water or to filter it properly before it is used for dietetic purposes.

I remain,
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WILLIAM CROOKES
(*For Self and Professor Dewar*).

R. W. STANILAND, Esq.,
BOSTON, LINCOLNSHIRE.

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WILLIAM CROOKES
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R. W. Staniland, Esq.,
Boston, Lincolnshire.

No. 9.

APP. A, No. 9.
On Sanitary Circumstances and Administration of Northam Urban District; by Dr Reece.

REPORT on the SANITARY CIRCUMSTANCES of, and ADMINISTRATION in, the NORTHAM URBAN DISTRICT, DEVONSHIRE; by Dr. R. J. REECE.

Recent annual and special reports of the Medical Officer of Health of the Northam Urban District having been deficient in information of a sort to enable the Board to judge of the sanitary condition of the district, of the work done by this Officer, or of the measures of sanitary improvement required to be carried out in the district, the Board decided on local enquiry by one of their medical inspectors, and this duty was entrusted to me.

The sanitary circumstances of the district have been the subject of inquiry by the Medical Department of the State on two former occasions. The late Sir Richard Thorne reported in 1871 on the district to the Privy Council; and in 1894 the district was inspected by me in connexion with the Board's Cholera Survey. Extract of my report thereon appears in the Inland Sanitary Survey Report, 1893–95.*

At my first inspection in 1894, I had the report of my late chief to guide me. At my recent inspection I was able to compare the present condition of the district with that which obtained at my inspection in 1894; this procedure being simplified by ascertaining from notes made at my former visit what alterations had since taken place.

I.—GENERAL SANITARY CIRCUMSTANCES OF THE DISTRICT.

Topography.—The Urban District of Northam is situated on the North Devonshire Coast. To the south are the Borough of Bideford, and the Rural District of Bideford. Its eastern boundary is formed by the River Torridge, which towards the north meets the River Taw. To the west it has the Atlantic Ocean.

The country is somewhat hilly, but varies considerably. A considerable portion is flat, as at the lower part of Westward Ho! and the Northam Burrows where the sea occasionally flows over the land. In places it is well wooded.

Geology.—Shillet (clay-slate), Devonshire culm, and limestone form the strata upon which the district is placed.

* Twenty-fourth Annual Report of the Local Government Board; Supplement in continuation of the Report of the Medical Officer for 1894–95.

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Division of the District.—For practical purposes the district may be roughly divided into five sub-areas, each having different characteristics. (1.) Appledore : a seaport, where there are ship-building yards and a dry dock.* (2.) Northam : itself a good size country village. (3) Orchard Hill: a residential neighbourhood, where there are many houses standing in their own grounds, but also some smaller holdings. (4) Westward Ho ! : a sea-side resort, with schools, golf-links, and a certain number of private houses. (5) Northam Ridge : a detached portion of the district, situated to the north of Bideford, purely rural in character.

As there is considerable diversity of character in these five sub-areas, it will be convenient in certain parts of this report to treat of each separately.

The district has been divided into four wards by the Devonshire County Council for election purposes ; these wards are Northam, Appledore, Westward Ho ! and Orchard Hill. Northam Ridge forms part of Orchard Hill ward.

Area, Population, and Inhabited Houses.—The Northam Urban District is partly within the Bideford Sub-district, and partly within the Northam Sub-district of the Bideford Registration District. The area in acres is 3,042, the rateable value is £15,918. The population at the census in 1891 was 5,043, and the number of inhabited houses 1,045. It is believed at the next census these figures will be substantially increased.

Roadways.—The approximate length of the roadways is,

Main Roads, about 4 miles,

Other Roads, about 19 miles,

Private Roads repairable by the owners, about 2 miles.

For the greater part they are gravel or macadam, and are kept in good repair, and well scavenged. There are streets, however, in Appledore irregularly paved and deficient in channelling.

Dwellings.—There are in Northam Urban District dwellings of many different types. Faulty building in the better class houses of the place did not come under my observation. As regards cottage property, it was noticeable that eavespouting was defective in a number of cases, and that many dwellings were damp. Some houses are back to back, each house having only two small rooms These are principally in Appledore, where also many of the houses are in a dilapidated condition. Westward Ho ! and Orchard Hill are practically free from insanitary cottage property, except for a group of buildings huddled together at Higher Cleeve Houses in the latter sub-area. A few old cottages have been pulled down in recent years, principally in Appledore.

The following table prepared for me by the Overseer, Mr. Labbett, shows the number of inhabited houses, obtained

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* The shipping of the district is for sanitary purposes under the control of the Barnstaple Port Sanitary Authority.

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by enumerating the separate ratings, classified as to rateable values, and apportioned to the five sub-areas just mentioned :—

TABLE (A), showing the estimated number of inhabited houses in five sub-areas of the Northam Urban District, and the number of such houses at certain specified ratings.

Division of District.	Estimated Number of inhabited Houses.	Number of Houses rated under £5.	Number of Houses rated over £5 and under £10.	Number of Houses rated over £10 and under £20.	Number of Houses rated over £20.
Appledore	568	447	86	32	3
Northam	279	204	52	16	7
Orchard Hill ...	140	52	20	7	61
Westward Ho! ...	129	16	30	29	54
Northam Ridge ...	13	8	2	2	1
Total... ...	1,129	727	190	86	126

From this table it will be seen that roughly 50 per cent. of the inhabited houses are in Appledore, 24 per cent. in Northam, 13 per cent. in Orchard Hill, 12 per cent. in Westward Ho! and only 1 per cent. in Northam Ridge. Further, the table shows that more than half the total houses in the district are rated at less than £5.

From Table A, another, Table B, has been prepared, showing definitely for each of the five sub-areas, as well as for the whole district, the ratio to total houses of dwellings at one and another rateable value.

TABLE B.—Showing for the five sub-areas, and for the whole Urban District of Northam, the proportion of the inhabited houses at certain rateable values.

Division of District.	Total inhabited houses.	Per cent. under £5.	Per cent. over £5 and under £10.	Per cent. over £10 and under £20.	Per cent. over £20.
Appledore	100	79	15	5½	½
Northam	100	73	19	6	2
Orchard Hill ...	100	37	14	5	44
Westward Ho! ...	100	12½	23	22½	42
Northam Ridge ...	100	62	15	15	8
Total... ...	100	64	17	8	11

It thus appears that small holdings are relatively most abundant in Appledore and Northam, and highest rated houses in Orchard Hill and Westward Ho !

This different distribution of poorer class dwellings will be seen to be not without significance when the details of the sanitary condition of each part of the district come to be considered.

Courts and yards are often imperfectly paved and drained, in some cases no attempt has been made to pave and drain them. This is especially the case at Appledore and Northam. Nevertheless, the conditions of many back yards has been distinctly improved since my visit in 1894.

Water Supply.—The water supply of the district for the greater part is derived from shallow wells. Some of these are only a few feet deep, others are from 30 feet to 40 feet in depth. A large number of these wells are mere holes excavated in the shillet; others have dry-steined walls, made of large-sized water-worn pebbles, apparently derived from the beach. For the most part these are to be seen at Appledore. From some wells the water is raised by means of a pump, or, occasionally, by any improvised arrangement, such as, *e.g.*, an old meat tin lowered by a string. Others, again, are, as has been intimated, mere dip wells. In the dry weather many of the wells fail to yield water. Failure in this way of groups of neighbouring wells has sometimes led to local water famine.

Many of these wells are so placed as to be liable to serious pollution. For instance, in a court at Appledore, a pebble-steined well was observed a few yards below certain privies and refuse tips. Surface water from the ground above the well and from the yard of a court hereabouts could flow directly into the well, and certain of the houses in the court have no water-closet or privy accommodation. At the time of my visit recently deposited human excrement was observed close to the mouth of a well. Slop water is also thrown on to the ground of this court, as the houses are not always provided with slop sinks connected with proper drains or gutters.

Appledore at present is very badly supplied with water.* Many houses have no water supply of any kind, and their occupiers are dependent for water upon the goodwill of their neighbours. Many of the wells excavated in the shillet are brackish when the tide is up. Certain houses are supplied with water by gravitation, through pipes laid on from springs, the result of private enterprise. There are wells of a public character to which the people can go to fetch water. The two principal public wells are some distance apart. One, known as Cawsey's Well, is in the village of Appledore. There is a plentiful supply of water from this well, which is only about six feet deep and is manifestly fed by springs. The walls are dry-steined, and the well is

* As an instance of this, the collars made at a local collar manufactory have to be sent to Bideford to be washed!

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close to the road-side, in proximity to houses; a few feet away from it is a coach-house, outside and against the walls of which refuse is thrown. The second public well, also evidently fed by springs, is at West Appledore. It is situated at the junction of the low cliff with the beach. At high tide the well would be reached by the sea water; and a dead animal washed up by the sea was recently deposited within a few feet of it. The greater number of the inhabitants of West Appledore fetch their drinking water from this well.

At Westward Ho! besides shallow wells such as I have described there are also two small private water supplies. One of these is at the United Service College, where water is pumped from a well to a reservoir on the hill side, whence it flows by gravitation to the College. The other is known as Mr. Taylor's supply. Here the water is pumped from a well to an open reservoir on the hill side, whence it flows by gravitation to houses on Mr. Taylor's property. Not much care would appear to be taken to preserve the water in this reservoir from contamination. The reservoir is situated on a steep hill side, and a much frequented road passes close to and winds partly round the reservoir from which it is separated by a wall. On higher ground than the reservoir is a house, the cultivated garden of which slopes down to the reservoir, and against the wall which separates this garden from the reservoir refuse is thrown. The reservoir is shaped like an irregular shallow cone; the sides are constructed of stone, lined with cement. Weeds grow in the cracks of the cement and between the stones, and vegetable life flourishes in the water.

At a conference which I had with the then Sanitary Authority of Northam after my inspection in 1894, I urged the necessity of providing an adequate supply of wholesome water for each household in the district. And subsequently from time to time the Board wrote to the Sanitary Authority and their successors, the Urban District Council, enquiring what steps had been taken to provide a water supply for the district. The usual reply to such enquiries was to the effect that the matter was receiving consideration.

In May, 1896, local complaints as to the defective water supply, which had become pressing, took the form of a petition to the Board, signed by many residents in the district. Some further correspondence between the Board and the District Council failed to lead to adequate steps for dealing with the matter in a comprehensive manner. And in August, 1897, formal application was made to the Board by certain ratepayers for action under section 299 of the Public Health Act, 1875.

This had the effect of inducing the Urban District Council to make serious effort to provide a public water supply. On September 9th, 1897, the Council formally resolved to apply for Parliamentary powers to carry out a water scheme prepared by Mr. Baldwin Latham. Thereupon the complaint under section 299 of the Public Health Act, 1875, was withdrawn.

On 25th July, 1898, an Act of Parliament received the Royal Assent authorizing the Urban District Council of Northam to

construct waterworks for the supply of their district, and for other purposes. At the date of my visit these works were in process of construction.

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The Urban District Council have acquired the freehold of some 160 acres of moorland at Melbury, in the parish of Parkham, outside the district, some five and a half miles distant, in a direct line from their boundary. The purchased land forms the upper part and sides of a valley. By building a dam across this valley it is estimated that a reservoir capable of holding 33 million gallons of water will be formed.

From the reservoir the water before delivery will pass to filter beds. These are three in number; each 24 feet 10 inches × 56 feet 9 inches × 8 feet. They are arranged so as to be used separately. The filtering material in layers from above downwards consists of sand, crushed limestone and sand, gravel, and broken limestone. From the reservoir the water runs into a pure-water tank 80 feet × 20 feet × 14 feet.

The dam has a puddle trench which varies in thickness, and is carried down to water-tight strata. The embankment of the dam is made of clay and stone.

From this pure-water tank the water will travel by gravitation through iron pipes to a service reservoir which will be placed just inside the Northam Urban District, above Westward Ho! where the Council have purchased about an acre and a half of freehold land; the line of pipes being some eight miles long.

From this service reservoir the water will be distributed by iron mains varying from 6 inches to 2 inches.

The estimated cost of the scheme is £26,000, but this amount will probably be exceeded before the work is finished. The work was, by the terms of the contract, to be finished in November, 1900. At the time of my inspection in July, 1900, the reservoir and filter beds at Melbury, and the service reservoir, had not been completed, and no pipes had been laid. £15,000 had already been paid to the contractor, and another £5,000 was about to be applied for by them.

It is considered that, on completion of the scheme, the whole of the Urban District, with the exception of the detached portion, Northam Ridge, will be supplied with water by gravitation.

A main road crosses the gathering ground, and this road has been diverted at its lower end to permit of the construction of the dam. The road, as diverted, is drained down the centre by a 12-inch pipe drain to carry the surface water of the road away from the reservoir. The gathering ground purchased by the Council is moorland in character, and is free from buildings, with the exception of a cottage near its highest point, which cottage it is proposed to use for the residence of a man who is to be placed in charge of the works.

The natural drainage of certain cultivated land, sharply sloping to the reservoir on each side, is taken into the supply. This

cultivated land has not been purchased by the Urban District Council, a circumstance which is somewhat surprising, inasmuch as the Council has had to make an accommodation road across to this land, and to build a small reservoir to supply three cattle-troughs with water on each side of the main reservoir. The cost of these works must have almost equalled, if indeed it did not exceed, the value of the land in question, the existence of which, under cultivation, must involve some degree of risk to the purity of their water supply.

Sewerage, House Drainage, and Excrement Disposal.

On account of the unequal distribution of the population, the uneven surface, and the wide area of the district, no single comprehensive scheme of sewerage is practicable. It will be convenient to treat of sewerage, and also of house-drainage and excrement disposal, separately as regards each of the four sub-areas, Appledore, Westward Ho !, Northam, and Orchard Hill. The isolated sub-area of Northam Ridge is so small that it does not call for detailed consideration.

(1.)—APPLEDORE.

Sewerage.—Many of the older sewers of Appledore are stone drains or culverts, originally constructed to carry the surface water into the tidal River Torridge, but afterwards used for sewage.

Some 20 years ago other sewers were laid down, consisting of 9-inch circular socketed earthenware pipe. These sewers discharge into a 12-inch intercepting main outfall sewer laid along the beach. They are ventilated by road gratings at manholes; these gratings, however, are often blocked up with road detritus. Many complaints were made by the inhabitants as to offensive smells arising from the manholes.

In September, 1897, after local inquiry, the Board sanctioned a loan to re-sewer Bude Street, one of the main thoroughfares in Appledore. This sewer, with a gradient of 1 in 12, runs from the top of Bude Street to discharge into the 12-inch intercepting sewer. It is a 10-inch circular stoneware sewer pipe jointed in cement. It is supplied with manholes and lampholes. Originally there were two 4-inch ventilating shafts, placed at the top of Bude Street, but these have been taken down on account of local objection.

A new sewer has also been laid in Market Street, a street which joins Bude Street at right angles.

The newer sewers in Appledore can be flushed with water from the hose of a water-cart. But in view of the scarcity of water such flushing takes place only at rare intervals.

At a point on the beach where the Bude Street sewer joins the intercepting sewer a manhole has been provided, the cover of

which is supposed to be water-tight in order to keep out the tide, and there is a hatch-box fixed in the manhole to prevent the reflux of sewage. At the time of my visit this manhole was covered with a large stone slab, and pebbles, &c., had deposited over it, so that the manhole was not to be seen. I am informed that it was found necessary to deal thus with the manhole as the tide had, at one time, "lifted" the cover bodily.

The intercepting sewer, constructed in 1878, is a 12-inch pipe running under the beach along the river frontage of Appledore. It intercepts the drainage from the various sewers laid down in streets, which are for the most part at right angles to the quay. It is continued to an outfall in Appledore Pool by a 15-inch pipe.

As vessels are moored alongside the quay for purposes of discharging or loading cargo, or for repairs, and as this main sewer with its branch sewers is in places only a few feet under the surface of the beach—some of them indeed can be seen at low water—it comes about that the weight of the ships occasionally breaks the sewers. As a result sewage escapes at low water on to the beach and creates a nuisance. At my visit my attention was directed to one of these breakages then existing. So long as the sewer pipes are unprotected and vessels continue to moor at the quay, such accidents will continue to occur.

Besides the main intercepting sewer there is, at West Appledore, a second small outfall sewer, which receives the drainage of some comparatively new houses. It is composed of circular socketed earthenware pipes and discharges on to the beach through a circular iron pipe 9 inches in diameter.

House Drainage.—Besides the dwellings which are served by sewers in Appledore, there are other houses which are drained to cesspools; many others again have their own drain pipe to the beach, and such drains generally discharge on to the foreshore above low-water mark.

There are a few houses with inside sinks discharging over gullies outside the dwelling. In others the pipe from the sink would appear to be in direct communication with the house drain. Also there are cases where a pump is placed in a kitchen or scullery, the overflow trough of which communicates directly with the house drain. In most instances the greater portion of the slop water is thrown down gullies in the yards, or on gardens where such exist. In some places, however, the houses, some of which are of the back-to-back type, have no drains of any sort or description.

Excrement Disposal.—There are a certain number of water-closets in Appledore. In the better class houses these are placed inside the dwelling and are usually flushed with water from a rain-water tank; when this supply fails, hand-flushing is resorted to. Occasionally the soil-pipe is continued up to the eaves for ventilation; these ventilating pipes, however, are not always taken up straight. Some soil-pipes are unventilated. The majority of the water-closets are outside the houses, and the larger proportion of them are hand-flushed. Certain of these water-closets do duty

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for more than one house, and some of them were found in very foul condition. In consequence of the scanty supply of water in the district these hand-flushed water-closets are seldom adequately flushed.

Many houses have midden privies, locally called "dung-pits," some of which serve more than one household. These receptacles are generally constructed partly below the surface of the ground; usually they are uncemented, many being mere holes in the ground. They are often not covered over, and their sloppy contents soak into the neighbouring soil. In some parts of Appledore the gardens are situated on a higher level than the dwelling houses, and it is in these gardens that the privies are generally placed. The duty of cleansing the privies devolves upon the individual householder. Instances were met with in New Street, Appledore, where the midden prives have been emptied only twice in the year, in particular cases once only in two years. Occasionally there is a pigstye in connection with the midden privy, but there are very few pigs kept in the district at the present time.

Many of the houses are unprovided with water-closet or privy accommodation of any kind. Inquiries instituted at such houses revealed the fact that in some cases commodes were kept in the bedrooms, and that the contents of such were emptied on the beach at irregular intervals. In other instances people appear ordinarily to "use the beach," or in the event of the tide being up, or the weather bad, any other spot convenient for the purpose. The accuracy of this information was clearly demonstrated by inspection of the district.

At the shipbuilding yards there are wooden privies built out upon the quay, and used by workmen employed in the yards. The excrement in these cases drops into the water at high tides, but on the beach at low water.

(2.)—NORTHAM.

Sewerage.—The original sewers here were mere rubble drains for surface water. Some of these rubble drains remain to-day. From time to time portions of them have been replaced by circular socketed pipes of 9 inches or 12 inches in diameter. One short sewer recently laid in Fore Street has manholes and ventilators. At one or two points on the sewers are flushing tanks, filled from time to time by hand.

The sewerage system of Northam, such as it is, has two outfalls, situate close together on meadow land near the village. This land belongs to a local farmer. The sewage discharged at the outfalls passes along open ditches through pasture land; partly it soaks into the soil, partly it gains access by way of the ditches or small streams to the sea. At one place there is a tank where sewage solids are deposited.

House Drainage.—In Northam the older house drains are probably mere stone drains. In recently built houses earthenware pipes are used. Slop-water sinks in the newer houses discharge over gullies in the open air. The greater part of the slop water, however, is thrown down gullies in the yards or on to the gardens. A few of the soil-pipes are ventilated, but it is seldom that these ventilating shafts are carried up without a bend.

Excrement Disposal.—The water-closets of Northam are rarely placed inside the houses. They are generally in the yards and are hand-flushed. The privy-pits and middens as a rule are uncovered, uncemented, partly below the ground level and generally sloppy. Cleansing of middens and privies is usually effected by the Urban District Council in the course of scavenging operations.

(3.)—ORCHARD HILL.

Sewerage.—A system of sewerage designed by Mr. Baldwin Latham was laid down in Orchard Hill in 1894, under loan sanctioned by the Board. The sewers are circular socketed earthenware pipes jointed in cement, and of 9 inches to 12 inches in diameter. The outfall is to the tidal River Torridge. Above the outfall is a tank sewer to hold the sewage when the tide is up. The outfall sewer proper is made of iron pipes and has a self-acting tidal valve. Ventilating shafts, manholes, lampholes, and flushing tanks are provided. This system of sewerage was extended, with the Board's sanction, in 1897 to a portion of the sub-area known as Raleigh Estate.

With this new system of sewerage many of the house drains were reconstructed and brought up to the level of modern sanitary requirements. Many cesspools were abolished. House drains at Cleeve Houses, where certain old cottages stand huddled together, appear, however, still to be far from perfect.

(4.)—WESTWARD HO!

Sewerage.—The sewering of Westward Ho! was carried out in 1870 and 1871. The sewers are circular socketed earthenware pipes of 9, 11, 12 and 15 inches diameter. There are in regard of these sewers no means provided for inspection, flushing, or ventilation. At the outfall is a tank in which solids are roughly screened off and periodically taken out to be sold as manure. The overflow from the screening tank passes through pipes to a ditch which crosses the golf links and discharges on the sea beach. A few houses at the lower end of Eastbourne Terrace have their own sewer, which discharges on to "the Burrows."

House Drainage.—The greater portion of the house drains in Westward Ho! have been laid down since 1870, and are in most instances of circular socketed earthenware pipes of 6-inch diameter. Where there are inside sinks they, for the most part,

discharge over gullies in the open air. But much of the slop water is thrown down gullies in the yards. In some cases gullies, which were originally in the back yards, are now practically inside the houses, owing to the back yards having been covered in.

Excrement Disposal.—The greater part of Westward Ho! is supplied with water-closets. There are inside water-closets in the better class houses, the soil-pipes of which are ventilated At Eastbourne Terrace the discharge pipes from certain inside water-closets appear to be carried down in the interior of the walls, and the soil-pipes are not ventilated. These inside water-closets are flushed with water from rain-water tanks while that supply lasts; but when it fails, there is an arrangement for flushing the water-closet with water from the house well, by converting the pump into a force pump. This proceding is objectionable, as it brings the drinking-water supply of the house into relation with the water-closet.

Arrangements for Refuse Disposal.

Appledore.—Appledore is scavenged by a man who receives from the District Council 18*s*. a week for his work, supplying his own horse and cart. The Clerk to the Urban District Council informed me, however, that no formal contract for the work had been drawn up. The district is supposed to be visited by this scavenger three days a week, when he removes all refuse, &c., placed outside the houses. Many of the houses open on courts and alleys, and in such cases refuse has to be carried down to the streets, a duty often neglected. Additional inconvenience is caused by there being apparently no definite day or hour for the contractor's visit. In consequence much of the refuse, and also the contents of privies, are disposed of in gardens, often dangerously near to wells, or are thrown over the quay wall.

Northam.—At Northam the Urban District Council undertake the scavenging, and a cart visits the district once a week for this purpose. The inhabitants are supposed to place their refuse in a receptacle outside their premises.

Orchard Hill.—The Urban District Council scavenge this part of their district, their cart making a round once a week. The same procedure is adopted as at Northam.

Westward Ho!—The Urban District Council undertake the scavenging of this portion of their district, the arrangements being similar to those already described. The refuse is "tipped" near by the tank on the outfall sewer at Westward Ho! It is disposed of for manure.

Common Lodging Houses and Tenement Houses, "Offensive Trades," Slaughter Houses, Bakehouses, Mortuary.

In the Northam Urban District there are no common lodging houses or tenement lodging houses, and no "offensive trades" are carried on. There are three slaughter houses, all in the

Northam portion of the district. Of these, one is a mere barn and its present condition unsuitable for slaughtering, and another requires structural improvements. Provisions of the byelaws as to slaughter houses are, in some respects, neglected. No list is kept of the bakehouses in the district. There has been considerable improvement in the condition of these bakehouses since my visit in 1894. Periodical lime-washing is not, however, enforced, and many of the floors were found to be dirty. In one instance an open ashpit was seen against the wall of the building containing the oven. There is a public mortuary at Northam village.

II.—SANITARY ADMINISTRATION.

The Urban District Council consists of 15 members, elected by the wards as follows:—

Northam Ward	3 members.
Appledore Ward	6 „
Orchard Hill Ward	3 „
Westward Ho ! Ward	3 „

The following byelaws are in force:—

Byelaw.	Date of sanction.
Nuisances	May 12, 1879.
New Streets and Buildings	October 26, 1867. May 12, 1879.
Slaughter Houses	May 12, 1879.
Cleansing Footways	May 12, 1879.
Prevention of Nuisance on the Seashore	October 26, 1867.
Public Bathing	October 26, 1867.

In many respects these byelaws are out of date, and they should be brought up to modern requirements.

Regulations made under Art. 13 of the Diaries, Cowsheds, and Milkshops Order of 1885 came into force in the district on 1st September, 1899. They had not at the time of my inspection been enforced. There is a Register of the Dairies, Cowsheds, and Milkshops of the District, but it did not appear to be kept up to date. On inspection, it was found that the dairies and milkshops were for the greater part clean and in good condition, whereas the cowsheds were the reverse.

The Infectious Disease (Notification) Act, 1889, was adopted and came into operation on 8th January, 1891. The Public Health Acts, Amendment Act, 1890, and the Private Streets Works Act, 1892, were adopted on 2nd January, 1900, and came into operation on 19th February, 1900. The Infectious Disease (Prevention) Act, 1890, has not been adopted.

The Medical Officer of Health is Mr. Frederick Pratt, M.R.C.S., L.S.A. He was appointed in March, 1898. He does not devote the whole of his time to the duties of his office, his salary being indeed only £10 per annum, no part of which is

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repaid from the county funds. The Urban District Council on making an appointment at this pittance could scarcely have expected to secure for their district an efficient health officer.

At the time of his appointment Mr. Pratt was 72 years of age. He served in the army during the Crimean War, and was at one time assistant-surgeon to the Leicester County Gaol. A native of Appledore, where he was indentured to his father in 1843, he has resided there continuously since 1871. His professional work of later years has not been such as to keep him instructed as to the progress of sanitary knowledge. The annual reports he has made on his district do not give information as to its sanitary condition, the work done there in sanitary matters, or the measures needed for its improvement. In dealing with infectious diseases, as to which he has taken some pains, Mr. Pratt has acted under the misapprehension that it was part of his duty to visit and examine patients notified to him under the Infectious Disease (Notification) Act, 1889, and to revise the diagnoses. This procedure on his part has led to friction with the local medical practitioners.

The statistical Tables A and B, which under the Board's Order form part of the Annual Report of a Medical Officer of Health for the two years 1898 and 1899, for which the present Medical Officer of Health is responsible, are in a chaotic condition. Comparison of Tables A with the list of deaths certified by the registrars to have occurred in the district, shows many inaccuracies in these tables. Presumably, as result of his assumption of the office of censor of cases of notifiable disease, his Tables B do not give a correct return of the infectious cases annually notified to him. For instance, in his Table B for 1899 the Medical Officer of Health has recorded only two cases of typhoid fever, but the details of some 14 notified cases (all occurring in the neighbourhood of Market Street, Appledore) have been supplied to me by local medical practitioners.

Inspector of Nuisances.—Since my inspection of the district in 1894, the office of Inspector of Nuisances has been vacant three times. At the date of my visit this year, Mr. William Chamion had just been appointed to the office at a salary of £40 per annum, and as Surveyor at £80 per annum. He had not entered upon his duties.

Since my inspection in 1894 several minor nuisances have been dealt with. But, as above indicated, in many places conditions obtain which call for energetic and prompt action on the part of this new officer.

Isolation Hospital.—There is no isolation hospital accommodation in the district, and no disinfecting apparatus. There is alleged to be considerable difficulty in acquiring land for the purpose of erecting a hospital for the isolation of infectious diseases. No steps, however, appear to have been taken to obtain land by compulsory purchase. The Devonshire County Council have not moved in the matter of the provision of isolation hospital accommodation for the Northam Urban District.

On a recent occasion, a case of small-pox occurring in the district was, as a favour, allowed to be transferred to the Hospital Ship of the Barnstaple Port Sanitary Authority.

The details of certain outbreaks of typhoid fever, supplied to me through the courtesy of the medical practitioners of the district, show clearly that want of isolation and skilled nursing has resulted in the spread of this disease to other inmates of the infected households, and to the relatives and friends of the patients.

The disinfection of houses invaded by infectious disease is nominally undertaken by the Urban District Council, but inquiries instituted by me revealed the fact that, in recently occurring cases of infectious disease, no attempt at disinfection of any sort had been made.

It will have been gathered from the above pages that administration by the District Council in sanitary matters has been, in many respects, seriously lax. The one substantial advance which they have made since 1894 has been the water supply scheme; and this they have undertaken only after persistent pressure from the Board, and from local residents. It is to be hoped that, now public opinion in Northam has become fully alive to the need of sanitary improvement, the District Council will, on its own initiative take active steps to ameliorate the numerous insanitary conditions which prevail.

To this end it is essential that the District Council should secure the services of active and competent officers, and should give adequate consideration to their recommendations.

I reproduce in addendum the recommendations which I made in 1894 as to matters which then appeared to call for careful attention and sustained effort by the District Council. Since then the authority has taken steps in providing a public water supply for the whole district, has improved or extended the sewerage of Appledore and Orchard Hill, and has made regulations as to dairies, cowsheds, and milk shops. But there remain, as will be seen from this report, a number of matters which still require to be dealt with by the Urban District Council in effective fashion.

I take this opportunity of expressing my thanks to the officers of the Urban District Council; to Mr. Thornton, Clerk of the Works of the Water Scheme; to Mr. Labbett, the Overseer; to certain of the medical practitioners of the district; and to others who afforded me assistance during my inquiry.

ADDENDUM.

DR. REECE'S RECOMMENDATIONS IN NOVEMBER, 1894, TO THE NORTHAM URBAN SANITARY AUTHORITY.

GENERAL DUTIES UNDER THE PUBLIC HEALTH ACTS.

1.—*Water Supply.*

The Sanitary Authority should themselves provide or cause to be provided for each household an adequate supply of wholesome water. They should see that existing supplies are protected from becoming fouled, and that polluted wells are closed under Section 70 of the Public Health Act, 1875. Special attention should be directed to the insufficiency of the water supply at the village of Appledore, and the Sanitary Authority is advised to at once take steps to provide a suitable and sufficient supply for this portion of their district.

2.—*Isolation Provision.*

* The Sanitary Authority is urged to provide sufficient and proper hospital accommodation for infectious diseases in place of the inadequate provision they now possess.

It is not necessary that the accommodation provided in the first instance should be on a large and costly scale, but it is essential that it should be ready before hand in order that the first person attacked may be promptly isolated.

Such hospital provision should include :—

(*a.*) A properly equipped laundry.
(*b.*) A mortuary.
(*c.*) A proper disinfecting apparatus for the efficient disinfection of infected articles.
(*d.*) A suitable and sufficient ambulance.

3.—*Sewerage.*

No unnecessary delay should take place in the provision of efficient sewers for all parts of the district ; such provision should include proper appliances for the effectual ventilation and flushing for all sewers.

4.—*House Drainage.*

The following arrangements should be recommended, and as far as possible enforced, by the Sanitary Authority in the case of such houses as are not new buildings :—

Each house drain should be provided with a suitable trap as near as practicable to its junction with a public sewer, so as to prevent air contamination between the public sewers and the private drains.

Drains should be properly constructed of socket pipes with tight joints. Defective drains which permit of soakage and lodgment of putrefying sediment in the neighbourhood of dwellings should be done away with.

All drains should be ventilated by means of two free openings to the outer air, so as to ensure the constant passage of pure air through them, in the manner laid down in the Model Byelaws of the Local Government Board. Waterclosets within houses should have a window or other opening communicating with the external air.

* At the time when these recommendations were made there was a galvanised iron erection for the isolation of infectious disease. I am not aware that it was ever used for the reception of patients. It has since been disposed of by the Urban District Council.

No. 10.

Report on the Sanitary Condition and on Sanitary Administration of the Bishop Auckland Urban District; by Dr. S. W. Wheaton.

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On the Sanitary Condition and Sanitary Administration of Bishop Auckland; by Dr. Wheaton.

From time to time the Board's attention has been directed to the unsatisfactory sanitary condition of the Bishop Auckland Urban District, and to repeated outbreaks of enteric fever in the district year by year.

In 1893 the district was visited by Dr. Sweeting, one of the Board's inspectors, in the course of a special survey which was made in that year in view of the threatened invasion of this country by cholera. In this year 106 attacks of enteric fever are known to have occurred with 17 deaths, and two deaths from continued fever. Dr. Sweeting, on completion of his survey of the town, conferred with the then existing Local Board, and left with that authority formal recommendations as to measures requisite for the sanitary improvement of the place, and for securing the health of its inhabitants.

In 1894, 88 attacks of enteric fever are known* to have occurred in the district with 13 deaths. There were also four attacks of continued fever. In 1895 four deaths from enteric fever are known to have occurred, and the same number in 1896. In 1897 seven deaths were registered from this cause. On January 1st, 1898, the Infectious Disease Notification Act came into force in the district, and in this year 138 attacks of enteric fever are known to have occurred in the district with 14 deaths, also eight attacks of continued fever. In 1899, 157 attacks of enteric fever were notified to the Medical Officer of Health, and 26 deaths from this cause occurred. Seven attacks of continued fever were notified with one death. Eight attacks of typhus fever were also notified in this year. In the year 1900 up to December 6th, 28 attacks of enteric fever have been notified with five deaths, and five of continued fever, with one death from this cause.

The special incidence of enteric fever on this district was also referred to, and its causation discussed, by the late Mr. T. W. Thompson in his Memorandum to the Board, "On the recent prevalence of Enteric Fever in certain areas within the County of Durham," dated September, 1895.

On March 28th, 1899, the Medical Officer of Health to the County Council of Durham prepared a report "On Enteric Fever prevalence in the Urban District of Bishop Auckland during the year 1898, and on the sanitary circumstances of the town," of which a copy was forwarded to the Board. This report referred the enteric fever to a polluted water supply and set out the sanitary

* The numbers of those attacked in 1893 and 1894 were, in the absence of compulsory notification, supplied through the courtesy of the local medical practitioners.

measures which were necessary to be taken in hand by the Urban District Council. Measures of the sort indicated were not, however, carried out to the satisfaction of the County Council, as shown by a further report of their medical officer made in November, 1899. In consequence the County Council drew the Board's attention to what they considered the "gravely insanitary condition" of the Bishop Auckland Urban District and finally on July 26th, 1900, the County Council urged the Board to hold a local inquiry into the sanitary condition of the district. Successive annual reports of the Medical Officer of Health to the Urban District had also disclosed many unwholesome conditions, while supplying very little evidence of efforts at permanent sanitary improvement. Also these reports showed, as did those of the County Medical Officer, an exceptional incidence of enteric fever in the district from year to year. The Board, having failed to obtain by correspondence with the Urban District Council evidence of active and decided measures for the permanent improvement of the sanitary condition of Bishop Auckland, decided on detailed inspection of the district by one of their inspectors. I was accordingly instructed to make such an inspection and visited the district on December 6th, 1900, and following days.

(a) General Sanitary Condition of the Bishop Auckland Urban District.

The district under the control of the Bishop Auckland Urban District Council comprises the town of Bishop Auckland alone. It has an area of 692 acres, and had in 1891 a population of 10,527 persons living in 1,992 dwellings. In 1881 the population consisted of 10,097 persons. At the present time the population is estimated at 12,850 persons. The town is situate on an elevated tableland and on a gentle slope towards the River Wear which forms the northern boundary of the district. The highest part of the town, the south, has an elevation of 393 feet above Ordnance Datum, from which there is a gradual slope to the level of 300 feet above Datum at the northern part near the town hall, where there is an abrupt fall towards the river, the bed of which is 220 feet above Datum. At the north-eastern corner of the town is situate the palace of the Bishop of Durham, Auckland Castle, placed in an angle formed by the junction of a stream, the River Gaunless, which forms the eastern boundary of the district, with the River Wear. The town is in the main built on each side of the old Roman road, the Watling Street, which passes through the town. The town is situate, therefore, in a very favourable position from a sanitary point of view, being in an elevated situation with free exposure to sun and air, and having a good fall everywhere for drainage. In the northern and more ancient part of the town, where the dwellings are old, there are many courts and yards which are narrow and badly lighted, and which contain dwellings badly constructed and so grouped as to obstruct the lighting and ventilation. At the higher end of the town, the south, a good deal of building has taken place of late years, and dwellings have

extended along the Watling Street up to the boundary of the district.

The town derives its present importance from its situation in the centre of a coal mining and agricultural district, and there are no trades of any magnitude carried on in it. There are two weekly markets at which a large number of people attend. The town is the centre of the Auckland Union, and the workhouse is situate in it. There is also a railway station, which is of importance as a junction from which several branch lines diverge.

The soil upon which dwellings of the town are situate is Boulder Clay overlying the coal measures. The latter have been extensively "worked" beneath the town and its neighbourhood.

Condition of Dwellings.—Dwellings which have been built of late years are usually well constructed, placed in rows with a frontage to fairly wide streets. At the rear of each row are yards abutting on a "back" street which affords approach to the privies of two rows of houses. Dwellings built from ten to twenty or thirty years ago, which constitute the majority, are also built in rows with yards in the rear containing privies which are common to two or more dwellings. These yards are approached by passages, and often are common to a large number of dwellings. In other instances passages between the dwellings lead to a narrow way running in the rear of the dwellings, and giving access to the privies and yards. In neither case are these passages wide enough to admit entrance of a cart, and consequently the contents of privies have to be wheeled in barrows through them, and deposited in a heap in the street. Yards and passages are paved with cobble stones or are unpaved; they are often badly drained, so that after rainfall water stands in pools in them. There are a number of back to back dwellings without means of through ventilation. Lastly, there are the dwellings in the northern and old part of the town. Here there are collections of dilapidated old buildings fronting the streets, having between them narrow passages leading to courts in their rear. The dwellings fronting the street have been built in a very irregular manner so as to obstruct lighting and ventilation. They have no curtilage, or have only a very small yard approached by a passage. This yard is often almost entirely filled by a midden privy of the most unwholesome type, often used in common by the inhabitants of two or more dwellings. Some of these dwellings are occupied by two or more families, and come under the heading of "tenement houses." The courts in the rear of dwellings in the old town are occupied by other and dilapidated dwellings frequently without windows in the rear or placed back to back without means of through ventilation. These dwellings are very damp owing to defects of eavespouting, want of damp course, and dilapidation of walls and roofs. The courts in question are narrow, so that dwellings are dark, owing to their too close proximity to one another and absence of windows in the rear; and this darkness is often increased by higher buildings overshadowing them. In the centre, or at one end of these courts, is found a collection of foul and offensive privies. The flooring

of dwellings in these courts is often of brick or stone laid upon the earth ; their interiors are foul and need limewashing. The yards are paved with cobble stones, and are often badly drained, so that the water stands in pools after heavy rainfall, and soaks into the ground in the neighbourhood of dwellings. In some yards there are long open channels of cobble stones or brick into which liquid refuse is thrown, and from which a great part of such refuse escapes by percolation into the ground before reaching the gulleys in which the channels terminate. There are two collections of dwellings in which the conditions above-mentioned are especially marked, and which form unhealthy areas which should be stringently dealt with by the District Council. These are at Town Head and Back Bondgate. In both areas there are dwellings which have fallen down from dilapidation, others which are dangerous from a similar cause, and some which have been closed by order of the District Council as unfit for habitation. The District Council have during the year 1900, and since the appointment of the present Inspector of Nuisances, dealt with a few of the courts by causing them to be paved with asphalt, and by providing water-closets, or small dry midden privies, in place of wet dilapidated and offensive privies. But no systematic action has been taken for improving the dwellings themselves, where they are capable of improvement, or for closing those which are incapable of permanent improvement. In 1899, 14 closing orders were granted by the magistrates, and 12 dwellings were closed permanently. In the year 1900 a closing order was obtained for 11 dwellings known as Monkhouse Cottages ; four of these have been pulled down, and the remainder are under repair. The condition of the streets, both public and private, was, at the time of my visit, extremely bad. Some of the public streets were almost impassable, both for foot and vehicular traffic. Many of the back streets were sloughs of filth and refuse, mixed with mud many inches in depth. Such a condition of the streets cannot fail to injuriously affect the health of the inhabitants.

Water Supply.—This is obtained from the River Wear as it passes the town. The waterworks are the property of the Urban District Council, and date from the year 1856. In the first instance water was collected from open-jointed pipes laid in the bed of the river, near Newton Cap Bridge, and conveyed by means of a collecting pipe to a well situate in the Urban District, near the same bridge. There a pumping station was built fitted with a steam pump by which the water was forced to a reservoir situate in the town near Clarence Street, from which it was supplied to the town in pipes by gravitation. The water was not filtered. These works are still in use, but the water taken at Newton Cap Bridge is only used to supplement a supply which has been more recently established. This latter supply was instituted in 1890, when the Council acquired West Mill Estate, consisting of a mill with water-power, which latter was utilised to pump the water to the town reservoir near Clarence Street. The water thus obtained is taken from the bed of the river at a point about half a mile higher in its course than that at which the water supplied by the old works is taken. The water is

collected by open-jointed pipes laid in the river bed and conveyed by a collecting pipe to a filter, from which it passes to a well, whence it is pumped by a force pump driven by turbines to the reservoir in the town. Previous to the year 1899 this water was supplied unfiltered, but in that year a filter was constructed which is at present in use, and an additional filter of similar size and structure is now in course of construction. When the river is in flood the turbines, which are worked by the mill race, lose their efficiency, and recourse has to be had to the old works at Newton Cap, where the boiler fires are always kept in, so that the steam pump can be used in case of emergency. Owing to floods and to the comparatively small capacity of the town reservoir, viz., 375,000 gallons, unfiltered water is from time to time supplied to the town. The filter at the West Mill works measures 88 feet by 64 feet. The filtering material is enclosed by brick walls, and the filtration is downwards, the filtering material resting on a layer of loose bricks, in the interstices of which the filtered water is collected and passes to a channel leading to the well from which it is pumped to the supply reservoir. The filtering material is all obtained from the bed of the river close by and is washed before use. The filter consists at the bottom of one foot of broken boulders, which are about four inches in diameter, this is succeeded by one foot of the same material, the pieces of which are two inches in diameter, and this in turn by one foot of the same material, the pieces being of one inch diameter. Above this is a layer of six inches of pea-gravel, and resting on this is a layer of two feet six inches of sand. There is thus a total depth of six feet of filtering material. The filter is not covered in. The depth of water resting upon the filter is two feet. The rate of filtration is said to be ten feet in twenty-four hours, furnishing from 350,000 to 370,000 gallons of filtered water in twenty-four hours. A supply of 30 gallons per head per day to the estimated population of 12,850 persons would require 385,500 gallons per twenty-four hours. The filter is cleansed when the passage of water through it becomes impeded. This operation consists in scraping off the layer of silt which forms on the surface together with about one quarter of an inch of sand. This cleansing is required once in every month or six weeks. At the West Mill there is also a well, 60 feet deep, sunk in the gravel near the river. The well is dry-steined with bricks, between the interstices of which the water percolates from the surrounding gravel. This well is stated to be capable of furnishing from 50,000 to 60,000 gallons of water per day, but hitherto no use has been made of the water owing to the want of pumping power. It is proposed to construct a steam pump and raise this water in the near future. In addition to supplying nearly all the dwellings in the Urban District, water from these waterworks is supplied to the villages of Southchurch and Binchester in the adjoining Rural District.

With respect to the quality of the water furnished by the River Wear there is no doubt that this river is grossly polluted, since it receives sewage from populous towns and villages within a few miles above the intake of the Auckland Waterworks. The County Medical Officer, in his report of March 28th, 1899,

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already referred to, states that he estimates that much of the raw sewage of a population of 10,000 persons, as well as effluent from sewage farms dealing with the sewage of over 15,000 persons, enters the river two or three miles above the intake of the Bishop Auckland Waterworks. At best the River Wear water at the point where it is withdrawn for the supply of Bishop Auckland is of, to say the least, doubtful quality. To supply such water in an unfiltered condition, which as has been said is done from time to time, is an absolutely unjustifiable proceeding. In order to avoid this without having resource to the curtailment of the supply it would be necessary to provide increased storage capacity at the supply reservoir, which will not at present hold a full day's supply; to provide new pumping power for use when the turbines will not act; and to provide two filters instead of one, in order that one can be in use whilst the other is being cleansed. In order also to provide for efficient filtration during periods when the river is in flood it will probably be necessary to provide a subsidence reservoir, in which flood water can be allowed to stand so that the suspended matter may be partially deposited before the water flows on to the filters. Whatever the precautions, however, owing to the danger of some breakdown in the filtering apparatus, the use of water from such a polluted source can never be free from risk. The District Council have no regulations relating to supply of water. Large consumers are charged in proportion to the quantity consumed, which is measured by meter.

Sewerage.—The Council have not caused plans to be made and kept up showing the position of all the sewers in the district. The position of some of the sewers is in consequence not known to the officers of the Council. Property owners have from time to time connected the drains of new dwellings to the sewers, apparently without supervision by the officers of the Council. The sewers, which were mainly constructed about the year 1850, have not all a sufficient fall, nor are they laid in straight lines. They form a sort of patchwork, some of them passing under dwellings, even beneath the floors of cellars, others having a curved or otherwise irregular course. In some instances the fall of a sewer is in the opposite direction to that which was originally intended. The majority of the sewers are constructed of tiles, locally known as segment tiles. These are flat tiles, and the drain or so-called sewer constructed of them is, for all practical purposes, identical with what is known as a rubble drain. These tiles are very soft, and decompose and crumble away; they are laid without any backing of hard material, and consequently are often found displaced; no sewer or drain constructed of them can possibly be water-tight. Other sewers are of rubble, or partly of tiles and partly of rubble. The bottom of a tile or rubble sewer is necessarily flat, and consequently the flow of sewage in it is not facilitated, and the sewer tends to fill with deposit. Sewers which have been recently constructed are of glazed socketed pipes. From time to time the old defective sewers become blocked by deposit, and many cartloads of filth have to be removed from them, causing much nuisance in the process. Some of them, *e.g.*, that in Frederick Street, are so

frequently blocked in this way that manholes have been lately constructed, giving access to them at intervals of a dozen yards or so, to allow of rods being pushed along between the manholes to clear away the obstructing deposit. Some attempt has also been made to ventilate these sewers by ventilating shafts, and to flush them by flushing chambers ; but it is hardly necessary to say that any money so spent on sewers of such imperfect and defective construction is wasted. In some of the sewers which I examined there was no flow to be detected ; the sewage appeared to be stagnant, and most offensive. I am informed that in warm weather complaints of sewer nuisance are very rife. From what has been said as to the defective construction of the sewers, it will be obvious that the subsoil of a great part of the town must be fouled by the escape of matter from sewers. This fouling, there is reason to believe, is becoming more serious at the present time, owing to the introduction of water-closets increasing greatly the amount of filth passing into the sewers. It is evident that very little improvement of these conditions can be effected until new and satisfactory sewers have been provided throughout the town. The sewage of the district escapes into the River Wear, without any attempt at previous purification, by a number of pipe outfalls at various points. At the higher part of the town there are several outfall sewers discharging into the River Gaunless which joins the Wear below the town. One of these outfall sewers conveys the sewage from the fever hospital to the river side, without any previous purification. Very little has yet been done by the Council in the way of taking up and relaying defective sewers.

House Drainage.—As a rule house drains deliver outside dwellings over traps, catchpits, or gullies, but there are some sinks inside dwellings which are not properly disconnected from the sewer. A good deal has been done of late in substituting proper gullies of glazed earthenware, with a water seal, for the old-fashioned dip-traps or stone catchpits previously in use. This has been done under the direction of the Inspector of Nuisances. I find that in the year 1899, 76 new gullies were provided for house drains, and 22 house-sink waste-pipes were disconnected from the sewers. In the year 1900 to the date of my visit 66 new gullies had been provided, and eight house-sink waste-pipes have been disconnected from the sewers. There is reason to think that very many of the house drains are composed of rubble or of socketless pipes, and allow of escape of filth from them into the subsoil; connections between such drains and the tiled sewers must needs be faulty and allow of leakage, since it is impossible to make a satisfactory junction with a sewer of this description.

Excrement disposal.—This is mainly effected by midden privies. There are at least 1,487 such privies in the district, and not more than 200 to 300 water-closets. These are the only two methods of excrement disposal in use in the district. The midden privies are of most unsatisfactory construction, and I did not see any even among those recently constructed which effected the proper admixture of ashes with the excrement so as to prevent

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nuisance as required by the Board's Model Byelaws. The majority of the midden privies are roughly constructed of bricks. The midden is partly sunk below the ground level, and neither the bottom nor the sides of it are cemented, consequently ground water enters the midden in wet weather, and in dry weather its contents percolate into the surrounding soil ; in many instances also water from neighbouring roofs and rainfall enters the midden owing to the absence of any covering. The number of privies discharging into a midden varies from one to four. One privy serves for from one to four dwellings. In nearly all instances the excrement accumulates beneath the seat of the privy, being retained there by the ashes and refuse thrown into the midden. Of late, in the case of new dwellings, the District Council have required the construction of smaller middens, and have also required them to be covered in and ventilated ; but in all instances the construction is faulty, and the privy is very frequently placed in such relation with the midden that the excrement is dammed up beneath the seat instead of mixing with the ashes. In July, 1900, the Council adopted a new plan and specification for a midden privy of improved form, but so far as I could ascertain, none of this type have yet been built. This midden privy will have a small receptacle beneath the privy seat only, and the lid of the seat will lift up so that ashes can be thrown in from the front, and thus properly mix with the excrement. The filth from this privy will be removed from a door abutting on the back street. A privy of this description will require more frequent emptying than is at present the case in the district, and will serve for one dwelling only. Nearly all the midden privies in the district require reconstruction, and it is unfortunate that the Council have, even recently, neglected the advice of their officers on this point and have allowed midden privies to be reconstructed in a very imperfect and unsatisfactory way, and not in accordance with the requirements of the byelaws now in force in the district.

Scavenging is performed partly by the District Council, partly by a contractor. The method is most unsatisfactory, and is such as to directly favour the spread of enteric fever. The contents of midden privies having been emptied into the road, street, back street, or yard, by men in the employ of the Council, it is the business of the contractor to remove the heaps of filth into carts and convey it out of the district. As the result of this system the ground of the streets, roads, back streets, yards and passages in the town is polluted by filth, which, owing to the endemic prevalence of the disease in the town, must often contain the infective matters of enteric fever. Frequently the contents of privies require to be conveyed a considerable distance in wheelbarrows along passages beneath and between dwellings, the entrance doors of which in some instances open directly from the passages. It follows that the filth is frequently spilt in these passages, which are narrow and dark, and is thence conveyed by the feet of the occupiers into the dwellings. The heaps of filth lie in the streets for some time before the contractor conveys the material away, and thus great nuisance occurs, as well as danger from infective matters blown from the heaps by the wind or washed from them

by the rain and conveyed by the feet of passers by into their dwellings. In some instances where contents of privies had to be wheeled long distances along passages the Council have required the provision of water-closets. Midden privies are emptied once a month, and the work of emptying them at the present time appears to be regularly performed; but in 1899 I am informed that the work was very badly done and large accumulations of filth were allowed to collect in the privies of the district. The work should be done at least once a fortnight, since many of the privies are very close to dwelling-houses, and in the case of those serving several families a large quantity of refuse accumulates in the course of a month. Moreover, in view of the difficulty of avoiding nuisance in the process, the work should be done for the present in the daylight. The contractor undertakes to convey the filth away between eleven p.m. and eight a.m. in June, July, August, and September, and between ten p.m. and nine a.m. during the rest of the year. Owing to their bad construction many of the privies are very difficult to enter, and it is impossible to cleanse them properly, consequently the liquid filth which gravitates to the bottom is frequently not removed. Recently, with the view of checking the spread of enteric fever, men have been employed to throw a solution of perchloride of mercury into the privies after emptying. With the same object pails have recently been provided to receive the excreta from cases of enteric fever; these pails contain a solution of perchloride of mercury, and they are removed daily from infected dwellings by one of the Council's officers, and their contents buried. The pails, however, are not provided with air-tight covers.

Disposal of Refuse.—Dwellings which have water-closets are provided with tubs for collection of ashes and house refuse, the contents of which are collected by the scavenging contractor twice weekly.

Nuisances arising from the keeping of Animals.—Nuisances from this source are not a marked feature in the district. The only nuisances of this kind requiring mention are those arising from the want of proper receptacles for horse manure in connection with stables, and from the throwing of stable manure into the middens belonging to privies in the absence of proper receptacles for this sort of refuse.

Slaughter Houses.—There are fifteen which are registered. In two instances slaughtering is done in the shop. The condition of the slaughter houses is very diverse, some are in good condition, others in very bad condition. The principal defects are faulty flooring allowing of percolation of blood and of filth into the ground or between the cracks or joints of the floor; dirty condition from want of limewashing; proximity to foul midden privies; and proximity to dwellings. There is no public slaughter house.

Cowsheds, Dairies, and Milkshops.—There are no milkshops in the district, the milk is usually carried straight from the cowsheds to the customers. There are seven registered owners of

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cowsheds, some of whom own more than one building. I examined twelve. Their condition is various, the most common defect being want of proper drainage and proper flooring, so that the manure accumulates about the feet of the animals; neglect of limewashing ; and the presence of nuisances, such as foul privies and accumulation of manure, in proximity to them. The District Council have recently made regulations founded on the Board's model with respect to dairies, cowsheds, and milkshops, which are now in the printers' hands.

Bakehouses.—There are very few of these. I examined five. The condition of most of them is not satisfactory. In nearly all cases they are old buildings, and often ventilation is defective or absent. The floors are often of some soft dusty material, cracked and uneven ; accumulations of dust and refuse on floors and in corners abound; and limewashing is needed.

Common Lodging Houses.—There are eight of these which are registered, and which I visited. They are all old and unsatisfactory buildings, but appear to be kept as clean as circumstances will admit. There is no provision in them for the seclusion of married couples, although a large number of such persons frequent them, from two to six couples sleeping in one room without screen or partition between the beds. In many instances the windows of the bedrooms will open at the bottom only, the upper sash being fixed, hence ventilation of the rooms is imperfect.

Isolation Hospital.—There is a hospital belonging to the Council within the district ; the cost of this has been defrayed from time to time out of current rates. The construction and arrangement of the hospital are not such as would meet the requirements of the Board in the case of buildings erected under their sanction. The original building consisted of some dog-kennels and sheds, and outbuildings pertaining to them. The original establishment has been added to from time to time, and the buildings are partly of wood, partly of brick. Quite recently a new brick building has been added as a ward for enteric fever. There is provision for 12 patients at this hospital, but all the wards, the nurses' bedrooms and sitting rooms, and the kitchens, are under the same roof and in direct aërial communication with one another. The building is only suitable for the treatment of one form of infectious disease at a time, but its use has not been restricted in this way. There is no unclimbable fence round the hospital, and there is no purification of the hospital sewage before it is discharged into the River Gaunless. The District Council have no ambulance, but at times the hand ambulance belonging to the Guardians is borrowed from the workhouse in order to convey a patient to the isolation hospital.

Disinfection.—The Council have no disinfecting apparatus. Occasionally infected bedding and clothing is sent to the oven at the workhouse belonging to the Guardians, which is intended for the destruction of lice in verminous clothing, where it is baked by the permission of the Guardians. This oven is of little value as a disinfector, although efficient for the purpose for which it was

intended. Disinfection of dwellings is performed by fumigation with sulphur under the supervision of the Inspector of Nuisances. Of late yards and drains of dwellings in which infectious illness has occurred have been flushed with a solution of perchloride of mercury.

(*b*) Administration by the Urban District Council.

The Medical Officer of Health is Mr. T. A. McCullagh, L.R.C.P., Edin., M.R.C.S., Eng. ; he receives £50 per annum, of which a moiety is repaid to the Council, and £25 as Superintendent of the Isolation Hospital. Mr. McCullagh has held the office for many years, and has from time to time drawn the attention of the District Council, and of the Local Board which preceded them, to the unwholesome sanitary condition of the district, and the need for widespread and systematic improvements. His advice has, however, been seldom asked for and for the most part disregarded. He does not attend the meetings of the Council except when specially requested to do so, although he reports to them in writing every month. The Council appear to think that they need no instruction in sanitary matters, and even in so important a matter as the construction and arrangement of the recently built addition to the hospital for infectious diseases the Medical Officer of Health has not been consulted at all.

The Inspector of Nuisances, Mr. Isaac Sanderson, was appointed in April, 1899 ; the joint office of Inspector of Nuisances, Surveyor and Waterworks Manager having previously been held by Mr. Robt. Lindsay. The salary of the Inspector of Nuisances is £100 per annum, of which a moiety is repaid to the Council. The Inspector gives the whole of his time to his duties. Mr. Sanderson has the certificate of the Sanitary Institute, and is an active and energetic officer. Since his appointment many gross nuisances have been remedied. In the year 1899, after his appointment, 77 statutory notices for abatement of nuisances were served, of which all but two have been complied with. In the year 1900 he has served 190 statutory notices for abatement of nuisances, 133 of which had been complied with up to the time of my visit.

The Surveyor is Mr. T. Collins, who has only lately been appointed ; he receives a salary of £150 per annum.

The Waterworks Manager is Mr. Robt. Lindsay, who formerly held also the offices of Surveyor and Inspector of Nuisances ; he receives £130 per annum.

The Inspector of Common Lodging Houses is Mr. John Cowan, Inspector of Police. For this duty he receives £10 per annum. The District Council have, in the year 1900, made byelaws for new streets and buildings, for common lodging houses, slaughter houses, hackney carriages, omnibuses, and for dealing with nuisances. These have recently received the Board's approval. The Council have not adopted the Public Health Acts Amendment Act, 1890, or the Infectious Disease (Prevention) Act, 1890.

The byelaws previously in force, which were sanctioned by the Home Office in 1868, were very ineffective and indefinite in their requirements. Thus the clause regulating the construction of water-closets, privies, and ashpits merely required that they should be subject to the approval of the Local Board as regards their situation, dimensions, materials, and construction, and should have an opening as near the top as practicable communicating with the external air.

From the foregoing account it will be seen that the sanitary condition of Bishop Auckland is extremely unsatisfactory. The work of the District Council has always been fitful and irregular: even when their officers have drawn their attention to very pressing and dangerous nuisances they have dealt with them in a spasmodic way, apparently soon subsiding into their normal condition of apathy towards all sanitary work. As the result of long continued inaction of the authority, the district now finds itself threatened by a sudden and heavy expenditure for public and private improvements which can no longer be shelved, which expenditure would have been spread over the the course of many preceding years if those responsible for local sanitary administration had only performed their duty.

With respect to the prevalence of enteric fever in the town for so many years, the general sanitary condition of the district is so bad that it is difficult to fix upon any single unwholesome condition as playing a principal part in the spread of fever. On taking into consideration all the circumstances of the distribution and progress of enteric fever in the district, there is presumption that the disease has from time to time been introduced and distributed over the district by means of a contaminated water supply. But however this may be, there can be no doubt that the further spread and prevalence of the fever has been effected and sustained by various unwholesome conditions, notably the faulty conditions of excrement disposal and scavenging in the district. It is also not possible to estimate the effect of the town as a centre for disseminating fever in the surrounding districts. Large numbers of people throng into the town at the two weekly markets, and no doubt many have contracted fever by partaking of refreshments which have been exposed to infection, or from walking about the streets and yards which have been fouled by excreta from specifically fouled privies, and these persons returning to their homes have probably conveyed the disease to surrounding towns and villages.

The sanitary needs of Bishop Auckland are numerous and urgent. They include—(1) The supply throughout the district of water of uniform quality and free from all suspicion of contamination. (2) The resewering of the district, including the removal of the old defective sewers and the disposal of the sewage from the district in such a manner as to avoid pollution of watercourses. In the process of laying new sewers the house drains should be examined and all defective ones relaid. The work of providing suitable trapped gullies to all house drains should be continued. When suitable sewers have been provided water-closets should be substituted for all midden privies which

are situate close to dwellings, or which cannot be approached so that their contents can be thrown directly into the scavenger's cart, or which are otherwise a nuisance. (3) The method of scavenging should be improved. Owing to the unsatisfactory construction, and difficult access to many of the privies, for the present the process should be carried out by daylight, and contents of midden privies should as far as possible be thrown directly from the privy into the scavenger's cart so as to avoid the dangerous contamination of the soil of the streets of the town which the present method entails. (4) The work of dealing with unwholesome and dilapidated dwellings should be proceeded with, and special collections of dwellings which cannot be made fit for healthy habitation should be dealt with as unhealthy areas.

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On the General Sanitary Circumstances and Administration of the Stroud Rural and Nailsworth Urban Districts; by Dr. Mivart.

REPORT on the GENERAL SANITARY CIRCUMSTANCES and ADMINISTRATION of the STROUD RURAL and NAILSWORTH URBAN DISTRICTS; by DR. F. ST. GEORGE MIVART.

For a number of years past representations have, from time to time, reached the Local Government Board concerning the want of a system of sewerage and sewage disposal in certain populous localities of the Rural District of Stroud, as well as the general pollution of the rivers and streams by sewage and the waste products of factories.

On the 4th October, 1899, a memorial was received by the Board from the Stroud Rural District Council complaining of the absence of any proper system of sewerage in the contiguous Urban District of Nailsworth, and of danger to the public health by reason of the discharge of nearly the whole of the sewage of Nailsworth into the stream which after leaving the Nailsworth Urban flows through part of the Stroud Rural District. The memorial further prayed for inspection of the locality by a member of the Board's staff. On the 3rd November, 1899, the local Medical Officer of Health reported the appearance of eleven cases of enteric fever at Cainscross and Ebley, and referred to the improper system of excrement disposal long prevailing in those localities. A review of the annual reports of this officer, and the correspondence therefrom arising between the Board and the Stroud Rural District Council, discloses the fact that for the past ten years the Board have been urging that body to formulate a scheme of sewerage and sewage disposal in those and certain other parts of their district. Such scheme having been at length submitted for the consideration of the Board, and the Nailsworth Urban District Council having, by letter dated 7th November, 1899, intimated their intention to wait and observe the result of the introduction of the system of sewerage and drainage in Stroud Rural District "before deciding upon the adoption of any fresh system of drainage at Nailsworth," the Board decided upon local enquiry into the general sanitary circumstances of both these districts. In accordance with instructions, I visited these localities at the close of the month of January of the present year, and on many subsequent occasions, the work of inspection having been much retarded by repeated heavy falls of snow.

THE STROUD RURAL DISTRICT.

A.—TOPOGRAPHICAL AND GENERAL.

The Stroud Rural District lies towards the centre of the county of Gloucester, and surrounds entirely the town of Stroud, itself the centre of a separate urban district. Viewed on the map, the rural district is roughly wedge-shaped from north to south; the apex of the wedge, which is to the south, being towards its

extremity turned sharply to the east. The greatest diameter is about 12 miles.

Near to the southern extremity the Rural District is completely cut across by the intervening Urban District of Nailsworth. The boundaries of the Rural District are as follows: on the north, Gloucester Rural District; on the north-east, Cheltenham Rural District; on the east and south-east, Cirencester and Tetbury Rural Districts respectively; on the south, Dursley Rural District; on the south-west and west, the Rural District of Wheatenhurst.

The district comprises seventeen parishes, some of which contain several aggregations of population, while in others, such as Thrupp, Chalford, and Rodborough, the population is spread over a considerable area.

The Stroud Rural District is divided between the Registration Sub-Districts of Bisley, Stroud, Painswick, Horsley, Rodborough, Minchinhampton, and Stonehouse. It is wholly in the Registration District of Stroud. The district consists entirely of hill and vale; lying among the Cotswold Hills, it possesses but little level ground save in the valleys or upon the high table lands. Many of the hillsides are exceedingly steep.

Speaking generally, it may be said that across the centre of the district, and gradually widening from near Sapperton in the east to the town of Stroud in the west, winds a main valley, which will be hereinafter referred to as the Chalford Valley. The town of Stroud is the point of meeting of this valley with other valleys and gorges running from Painswick in the north, and from Nailsworth and Woodchester in the south, the main valley thence running westward to Stonehouse. Along the last-named the River Frome, the Thames and Severn Canal, and the Gloucester line of the Great Western Railway, continue their course after passing down the Chalford Valley. The River Frome is joined near the level of the Town of Stroud by several affluents, which reach it after descending the branch valleys just referred to.

As regards geology, the district rests principally on various beds of the Lower Oolite series and, below these, on the Lias. These beds consist of an alternation of limestones and clays; the former being marked on the hillsides by steep escarpments, while the clay beds form gentler slopes and occupy the bottoms of valleys. Where the limestone beds rest on clay, numerous springs are met with, and these, with wells generally of shallow depth, form the local water supplies of the villages, the position of which has obviously been determined in many cases by the existence of these facilities for obtaining water.

The industries are very numerous. The manufacture and dyeing of woollen materials, both from wool and from shoddy, are carried on extensively. The locality, indeed, enjoys a special reputation for the production of a scarlet dye which is said to be unequalled elsewhere. There are several considerable breweries; also brass foundries, pin factories, corn mills, timber works, and walking-stick factories. These various factories are placed

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along the course of the several streams, in order to take advantage of the water power thus obtainable; they also thus secure, as will be hereafter shown, a convenient means of disposing of refuse chemical matters as well as of sewage.

Owing to alterations, from time to time of late years, in the boundaries of the district the present population cannot be estimated other than roughly, but may be thought of as about 30,000; while the number of inhabited houses may be taken to be about 6,800, an increase since 1891.

B.—General Sanitary Circumstances of the Stroud Rural District.

Roads, Dwellings, and House Accommodation.—There are 210 miles of dedicated roads repaired by the Rural District Council; these are now in very fair condition, a considerable amount of good material having been recently laid, and many miles having been rolled with a steam roller. I am informed that the exact extent of undedicated roads is not known, but that it does not exceed five miles.

Throughout the district houses are grouped together in little clusters, to each of which a separate name is given. The dwellings are, for the most part, of a substantial character, more particularly the older ones, which are built of stone and roofed with stone tiles. Houses erected in more recent years have been generally built of brick and roofed with slates. Among the older groups of dwellings back-to-back houses are by no means uncommon; on the hillsides back-to-earth houses are frequently met with, and some of these were strongly complained of in respect to dampness. In some cases where houses have been built into a bank, the earth has been excavated behind the house to the extent of a few feet, but a suitable arrangement for the prompt removal of storm water by drainage has not been made. In not a few instances eave-spouting is altogether absent. Spouting of some sort, however, generally exists, though very often of a defective kind, but down-pipes rarely deliver over gullies or over gutters leading thereto. They are more often used to obtain a supply of soft water, which is stored in butts, and where, as had happened in not a few instances, these had been removed, the down-pipes discharge the water upon the ground close to the foundations of the houses, such ground being, with very few exceptions, entirely unpaved. I met with several instances of dwellings which, owing to extreme dilapidation supervening upon unsuitable position, especially in regard to liability to flooding, should be declared unfit for habitation until placed in a state of substantial repair. In some cases, too, structures evidently not erected as dwelling-houses have been let as such, a rent as low as 9d. per week being charged. Garden ground, where such is specially needed for sanitary purposes, is frequently insufficient and undesirably situated, having regard to the disposal thereon of excreta from privy vaults. This is especially the case on the steep sides of valleys, where houses are generally

placed in terraces, with very small patches of garden attached to them.

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Water Supply.—The water supplies of the district may be thus classified:—

(*a*) Public water service.
(*b*) Wells.
(*c*) Springs.
(*d*) Streams.
(*e*) Rain water stored in tanks.

But in every parish, almost without exception, may be seen examples of supply by wells and springs, even when the mains of the public water service are available.

(*a*) The only *public water service* in the district is that furnished by the Stroud Water Company.

This Company was incorporated by a special Act of Parliament, cited as the "Stroud Water Act" of 1882. The limits of distribution of the Company's water were determined as the Parish and Township of Avening, Bisley, Chalford, Haywardsfield, Horsley, King Stanley, Leonard Stanley, Minchinhampton, Nailsworth, Painswick, Pitchcomb, Randwick, Rodborough, Stonehouse, Stroud, and Woodchester. From Mr. Geo. Scriven, Secretary and Manager of the Company, I learn that Painswick has been definitely abandoned; he also informs me that, in all, 1,673 houses in the whole Rural District are supplied with water, such supply being in ordinary seasons constant. The water is obtained by pumping from several wells and headings situated at Chalford, on the southern slopes of the valley, and descending to a depth of about 80 feet. Thence the water is, for softening purposes, pumped to two lime tanks, whence it passes to two settling tanks. From these the water is pumped to a reservoir on Minchinhampton Common, holding 1,000,000 gallons, whence it flows by gravitation to the whole of the district. In summer, especially a dry one, the yield falls off considerably. In that of 1899 there was great scarcity, but Mr. Scriven states that only households living at the highest points in the district were inconvenienced. The absence of storage was a special difficulty. I am informed that no filtration is needed. The Company have the water analysed on their own initiative from time to time; the District Council cause the water to be analysed in their own interest once a year. In the Appendix will be found copies of the only analyses of recent date that I was able to obtain.

Under clause 48 of the "Stroud Water Act" the Stroud Urban District Council have the right to supplement their own supply by drawing from the Stroud Water Company's main; but if the Urban District Council shall require, on any one day, more than 100,000 gallons, they shall give the Company 14 days' previous notice, in writing, and in such case they shall be bound to continue to take not less than 100,000 gallons for not less than 14 consecutive days, and must give 7 days' notice before discontinuing such extra supply.

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With regard to the other sources of water supply above referred to, they must all be regarded as unsatisfactory, and that too, not merely by reason of the yield becoming insufficient in dry weather, but also because of the excessive distance over which cottagers are frequently compelled to travel in order to make use of them.

(*b*) *Wells.*—I saw no wells that had received any internal treatment other than dry steining, usually by means of blocks of local stone, the joints of which are frequently wide apart. They vary in depth from 20 to 80 ft., according to situation, the deepest being usually on high ground. Other wells seem to have no steining except near the top, and to be rather of the nature of deep tanks hollowed out in hard strata. Wells of this description were seen at Minchinhampton, and were, in several instances, stated by cottagers to yield water apparently affected by every fall of rain.

In the neighbourhood of Park Terrace, in that town, two such wells were inspected. A sample of water drawn was seen to be turbid, in consequence, it was alleged, of hailstorms on the previous day. In the roadside adjacent I was shown certain small drainage pits which had been dug, under the authority of the County Council, to get rid of storm water. These pits were covered with grids. They are apparently roughly bricked inside, and water collecting in them is said to disappear rapidly through fissures in the strata. I was disposed to think that they may communicate with the deep tank wells above referred to.

Wells are also insufficient in number for the supply of groups of houses. Examples of this insufficiency were seen in Rodborough, Leonard Stanley, Minchinhampton, and elsewhere.

At Butter Row (Rodborough) Board Schools the new buildings have been erected without any proper water supply for master or scholars. For lavatory purposes and for the hand-flushing of the closets a rain-water tank has been placed under the playground. It is filled with water from the roof, and a pump has been fixed. But this water is not thought suitable for drinking; moreover, in dry weather the tank is soon emptied. Water must then be carried, not only for drinking and household purposes, but also for handflushing the closets, from a spring upwards of 200 yards distant from the schools.

Many wells were seen which are evidently liable to pollution from the direct passage into them of filth from the surface of the ground; the collars and covers being ill-fitting or broken. In others soakage of liquid from the surface and upper layer of soil forming part of fold-yards, chicken runs, manured gardens and the like seemed inevitable; in some cases dripping or trickling was noticed at the wellsides, in others the sides were heavily grown with vegetation. Wells to be regarded with suspicion for these reasons were seen near slaughter-houses, but such wells are generally covered in with masonry and are fitted with pumps.

Conspicuous examples of these various defects of wells were seen at Cainscross, Ebley, Dudbridge, Rodborough, Stonehouse, and Painswick. At the last-cited place a roughly-steined well, with ill-fitting wooden collar and broken cover, was sunk in ground used as a chicken run. It was stated that from this well water was taken for washing milk vessels at a dairy, though it was stated that this water is boiled before being used.

Some wells were met with to which, though situated on private ground, a quasi-public right of access seems to be established. Such wells not infrequently yield water said to be fit only for household purposes other than drinking; but having regard to

constant summer scarcity there is no doubt that this water is at times also used for drinking. Examples of this were seen at Painswick, Minchinhampton, and other places.

(*c*) and (*d*) *Springs and Streams.*—The district is one abounding in natural water supplies for a large portion of the year. Springs or streams, or both, are found in every parish in the district. In some rare instances, as at King Stanley, the springs have been utilised to feed standpipes or spouts; near the last named place, at a cost, as I am informed, of about sixty pounds, an apparently good supply has been secured for a portion of the locality. But, generally, the springs are allowed to flow over the ground without regard to polluting agencies, and the resulting brooks and streamlets are already seriously contaminated ere they reach a point where they might, at a trifling outlay, furnish a much-needed water supply for one and another locality. Most of the villages in the district have roadside spouts to which water is piped, but in numerous instances I heard that the flow from these is either greatly diminished or ceases entirely in dry seasons, such as last summer.

In several instances streams flow in culverts through village streets, and even pass underneath the houses to the inhabitants of which they may furnish a supply of drinking water, or of water for household purposes other than drinking, by means of dipping places. An example of this is seen at Horsley. The contamination of such streams from time to time may be looked upon as inevitable, and in this case indeed I heard complaints as to the occasional passage of undesirable adjuncts such as petroleum, blood, offal, or slop liquids which, cast in above, may be drawn out by consumers at a point lower down. Occasionally these dipping places are a source of danger to children. At King Stanley I heard of the accidental drowning of a child in one of them. Moreover, in the case of the latter stream complaint was made here and there of occasional nuisance from foul-smelling accumulations of solids in its course.

(*e*) *Rain-water Tanks.*—The method of obtaining a supply of water for drinking and other household purposes by the collection of rain-water in underground tanks cemented internally is met with on the highest situations such as at the Small-Pox Hospital at Burleigh, Minchinhampton, and elsewhere. Such supply is evidently intended to be supplementary to that obtained from wells, but apparently it fails usually at the time that wells and springs are at their lowest.

Speaking generally, the water supply of the district must be described as insufficient or uncertain in quantity, while there is good reason to regard a considerable portion of the private supply with suspicion as regards quality.

Sewerage.—The only parish furnished with sewerage upon a definitely known plan is Stonehouse, in which the town of that name has a system of sewerage laid in 1884 at a cost of £3,000, for which sum a loan was sanctioned after an inquiry held by Mr. Codrington, one of the Board's engineering staff. The

sewers were extended in 1887 at a cost of £500, for which further sum a loan was also sanctioned. The pipes are glazed, and range in size from 9 inches, 12 inches, and 18 inches, to two feet at the outfall; they are said to be jointed with cement, and laid at good gradients. Flushing tanks on the sewers have been provided, but these have never been used as the local water supplies are insufficient. The Inspector of Nuisances asserted that the flushing of sewers obtained by means of slopwater is sufficient: if necessary, they could be further flushed by water taken from the canal by means of carts. The sewage is conveyed through an iron main under the canal and under the river, and finally passes through an open leat between 30 and 40 yards long into a duplicate system of receiving tanks, where, after being treated with lime, it passes into settling tanks, and thence, by upward filtration, through a bed of gravel to an outfall into the "Bannie Brook," a streamlet fed by an overflow from the Frome just above a mill. The flow in this brook is controlled by the mill owner, but the level of the water in it, at present arranged to suit his convenience, could be altered. It is evident that when the overflow from the Frome River to the "Bannie Brook" ceases there must be considerable nuisance arising from the exposed bed of the latter, which I saw once in a foul condition, although at the time of my visit the effluent from the sewage tanks was fairly clear. The sewage tanks are situated near the road from Stonehouse to Leonard Stanley in about an acre of roughly enclosed land. In this enclosure the refuse from the scavenger's cart has been deposited, and sludge removed from the tanks is also placed there. A few yards only from this spot is a row of cottages, inquiry at which showed that nuisance is from time to time experienced owing to the foul smell given off at the sewage works.

The town of Minchinhampton has been provided with several sections of sewer forming a small system laid thirty years ago, on his own initiation, by the late Mr. H. D. Ricardo, a landowner in the neighbourhood. The nature of these sewers I was unable to ascertain, some persons asserting that they are, in part at any rate, glazed pipes, while others as firmly maintained that, to their own knowledge from inspection when connections were being made, these sewers are of the nature of stone or brick culverts. But of whatever kind they may be, they pass down a steady slope and discharge by a main outfall into a tank in a field at "Well Hill." This tank, which is rendered in cement internally, is about 22 ft. by 9 ft. by 6 ft. deep, and is provided at the farther end with a gravel and shingle filter for arrest of solid matter, the effluent passing into a ditch and ultimately reaching the Avening and Nailsworth Brook. At the time of my visit the tank was overfull of sludge, and the liquid was running over the top of the filter. When the tank is cleaned out the sludge is removed to agricultural land in the neighbourhood by the owner of the field, who is employed by the Rural District Council to attend to these sewage works; but I gathered that there is no clearly defined system of supervision. The tank is well removed from habitations, and I heard no complaints of nuisance caused by it.

The closely-built town of Painswick, situated at a height of about 500 feet above Ordnance Datum, is provided with stone drains of considerable antiquity. They are stone channels, in section either square or oblong, with, for the most part, earth bottoms. These drains, now called and used as sewers, were undoubtedly intended originally for the disposal of surface water, but now water closets in increasing numbers have been directly and indirectly connected with them. Since they are laid with irregular gradients, are often flat, and have many turns and angles, there is much accumulation of foul matter in them. They are unprovided with any means of flushing; and except for a few ventilating pipes recently put up, downfall pipes from houses, and untrapped closets, they are unventilated.

At one point specially complained of, I caused a sewer to be opened; the bottom was found to be covered with several inches of black stinking sludge, excrement and paper being clearly discernible. These sewers are often only a few inches below the roadway surface. They have four outfalls into the brook descending from Painswick. One of the great dangers of these sewers is the constant soakage of fæcal matters from them into the surrounding soil, and the consequent pollution on a large scale of the already scanty water supply of this place.

The constant menace to the public health by this unwholesome system of sewerage has been annually dwelt upon by the Inspector of Nuisances concerned.

The sewerage of the ancient town of Bisley is of a similar character, though comparatively inoffensive, as few water-closets are connected thereto. The Inspector of Nuisances informs me that no fresh connections have been made since 1896.

The populous part of the parish of Thrupp is practically sewered with sections of pipe sewer, said to be generally well laid and to be satisfactory save as regards ventilation and flushing; but the outfalls here, as also those of the sections of sewers and drains at Chalford, discharge into the river Frome, flowing down the Chalford Valley.

An extensive plan of sewerage and drainage has now been brought forward by the Stroud Rural District Council, and on the 1st of February of the present year an inquiry was held by Colonel Durnford, R.E., of the Board's Engineering Department, into an application for sanction to borrow £26,000 for that purpose. Three separate outfall systems are arranged for in this scheme, viz., one embracing the whole of Cainscross and the greater part of Rodborough; one including the greater part of Thrupp and that part of Brimscombe lying in Thrupp Parish; and another, the remainders of Rodborough and Thrupp respectively. The proposal is to treat the sewage by means of septic tanks and filters, the effluent to be discharged into the River Frome. The scheme is now under consideration by the Board. That the whole district, and the Parish of Cainscross especially, need a sewerage scheme there can be no doubt. My only criticism of the present proposal—assuming always that the Board's Engineering Department approve the proposed situation

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of the tanks and filters—is that it might with evident advantage go further and take in that part of Brimscombe lying south of the Frome and in Minchinhampton Parish. Burleigh might also be included, and, in my opinion, to include North and South Woodchester would be an improvement. I cannot, indeed, help thinking that the Urban District of Nailsworth should be pressed to avail itself of the convenient proximity of a main sewer in order to finally rid itself of the many filth nuisances referred to in the part of my report dealing with that locality. I am assured that there is a steady fall all along the valley, running down from Nailsworth to the River Frome in the Stroud valley. I infer also that the long line of objectionable privies emptying into the river along the valleys will be untouched by the scheme now being considered.

In other parishes, such as Chalford, Rodborough, and Cainscross, road and storm drains discharging into the River Frome or the canal have been converted into sewers by the surreptitious connection of water-closets with them.

Where house drains are not connected with the sewers already referred to, they discharge into streams, water courses, or ditches. As to ditches, abundant evidence of nuisance thus brought about was obtained in all parts of the district, one of the worst being met with at Cashes Green, though it is fair to add that the new sewerage and drainage scheme will, if carried out, probably remedy this particular instance. Where no house drains exist, slops are cast upon gardens; and where such are not available, they are thrown into the road or in any convenient spot. Many curtilages were found to be habitually fouled by this practice.

Excrement and Refuse Disposal.—In this conection, perhaps, the most striking feature of the district is the common custom of placing privies over the edge of streams and water-courses—wherever such a position is practicable. This system of excrement disposal may be seen throughout the extent of the Chalford and the Nailsworth Valleys, and the lateral valleys connected with them. Now and again, where a footbridge crosses a stream immediately adjacent to such a privy, a screen of some sort is affixed to the privy structure to hide the fall of fæces into the water. All the factories along these valleys, practically without exception, employ this method of disposal of excreta.

In the part of the district lying directly upon the Great Oolite the usual method of disposing of excreta is by turning them into some of the innumerable fissures found in the strata. To these fissures the local name of "lissens" is given by the quarrymen. Mr. Woodward, F.R.S., of the Geological Survey, whom I consulted upon this subject, gives it as his opinion that matters sinking into these fissures pass completely through the stratum down to the deposit of Fullers' Earth, by which the water beneath the Oolite is held up. Serious contamination of the underground water supplies is thus rendered probable.

At France Lynch, Minchinhampton, Burleigh, and elsewhere on the end of the southern slope of the Chalford Valley, this system of getting rid of excrement is very general: and here-

abouts I met with privy vaults which, according to the householders' statements, had not been cleared out for many years, the inference being that the contents soaked into "lissens." In other parts of the district privy vaults are met with, such vaults being frequently mere excavations in the ground. In some cases, as at Cainscross, they were found to be placed against the wall of the dwelling-house. The contents of the vaults when emptied are usually buried in gardens. The amount of this garden ground has already been referred to as often insufficient.

A method of disposing of urine, still common in parts of this district—as in other cloth-manufacturing localities—is to collect it in large barrels holding forty or fifty gallons. These barrels are partly sunk in the ground and—especially at public-houses—form convenient urinals. The local name of these receptacles is "Segg barrels." When full, the contents of these barrels are removed by a carrier and conveyed either to local nursery gardens or, more commonly, to cloth mills, where the "Segg" or highly ammoniacal urine is stored in vats and is used for soaking freshly-made cloth. I found that the average price paid to householders for stale urine is about $\frac{1}{2}$*d.* per gallon. Pig manure is also collected and mixed with the urine for the sake of the ammonia. The conveyance of these commodities along the roads is undoubtedly a nuisance. There is no doubt that the use of ammoniacal urine and pig manure in cloth mills has diminished, but it is still prevalent. I found the utmost difficulty in obtaining information on this subject, all parties concerned being extremely reticent. As a rule I found that individual mill owners denied that any "segg" was used on their premises, though they generally indicated other mills where it was employed. A partly successful effort has now been made to restrict to early morning and evening the time when urine may be carted along the roads.

In the village of King Stanley alone I found four public-houses where "segg barrels" were kept as urinals, though it was asserted, and I believe truthfully, that the contents are not taken to the mills, but emptied on the gardens. As there is no system of sewerage in the locality, the traditional method of urine disposal is still adhered to, although the original purpose for storing it no longer exists. One householder with whom I remonstrated concerning a very foul "segg tub" said, "What else can we do? There are no 'lissens' in this part."

On steep hillsides the overflowing of privy vaults upon lower slopes is a frequent occurrence, as is also the discharge of house drains on to the roads and pathways. Examples of this were seen at Woodchester, Brimscombe, Rodborough, and elsewhere. Prompt, though temporary, abatement of this nuisance is generally secured.

The *disposal of house refuse* is likewise unsatisfactory; only in the Parishes of Cainscross, King Stanley, and Stonehouse is any public scavenging carried out, and in these the respective parochial committees have entered into contracts under which, on one day in each week, the contractor's cart removes refuse for those householders who place it ready in receptacles beside the road. But on the occasion of one of my visits to Ebley, which is an urban portion of Cainscross Parish, I saw at 3 o'clock in the afternoon boxes and pails of refuse still awaiting removal.

It is only fair to add that from what I saw in this and other localities I judged that many cottagers do not take advantage of the convenience offered them in this respect. The selection of places for "tipping" the refuse is not always judicious. At Cainscross I found a large gravel pit close to the centre of the town being used for the "dumping" of these matters. In all parts of the district I saw a good deal of house refuse lying about in curtilages and gardens. In the riparian portions of many parishes, such as Minchinhampton, Chalford, Rodborough, Cainscross, and elsewhere on the steep hillsides, the nuisance is prevalent and is constantly receiving the attention of the Inspectors of Nuisances.

In the whole district I saw very few ash-pits, and in no instance was a cover provided for them.

No register is kept of *slaughter-houses*. Some of them are placed in undesirable situations, surrounded closely by dwelling-houses; and the general condition of most of those visited is unsatisfactory in respect of ill-paved (or even unpaved) uneven flooring with the wide crevices between the stones allowing soakage into the soil of blood and filth, foul walls, absence of proper drainage, blood allowed to escape into the roadway or into ditches and water-courses, accumulation of offensive manure, with offal thrown upon it, and the like. I particularly noted a number of what may be termed occasional slaughter-houses, that is to say, places in which "a pig or two a week" are said to be killed. Cross-questioning of the owners of these places generally elicited the admission that "a sheep or two" are also killed, with the addition, in some instances, of "a beast or two" at certain seasons. Some of these places are mere barns or cart-sheds, without any proper slaughtering arrangements whatever; they constitute an undoubted danger to health. One of the worst kept slaughter-houses seen by me was a newly-erected one at Cainscross.

There is no registration of *dairies, cowsheds,* or *milk shops.* For the most part the dairies visited were fairly clean; but in most instances they were found to contain articles of food, such as meat, bacon, &c., and frequently to be deficient in ventilation and light. One dairy I found in a cellar reached by a staircase beneath the floor of a small grocer's shop. In another dairy I found "mangling" is carried on. Another I found to be part of a dwelling-house, and to be used, apparently, as a convenient receptacle of the odds and ends of an untidy household in addition to milk and butter. The water supply to dairies was frequently found to be of a very doubtful character.

The condition of the cowsheds visited is bad. The cubic air space allotted to the cows is often insufficient, as also is the ventilation. Particularly on the steep hill-sides fold-yards were found to be deep in filthy liquid, and large quantities of manure were seen stored adjacent to cow-byres. Surprise was expressed that these arrangements should be considered faulty.

The condition of the *bake-houses* visited was, on the whole, fairly satisfactory, though the water supply is sometimes of

doubtful quality. In one large newly-erected bakery I found that the freshly-baked bread was stored in close contiguity to a large refuse pit.

I heard of no offensive trades though, from the foregoing notes, it will be apparent that certain trades, not by statute denominated offensive, are so carried on that risk to public health is caused. I received several complaints as to nuisance caused by pig-keeping, and in many of the more populous localities I found pigs being kept in such a way that undoubted nuisance was being created owing to the want of any proper means of getting rid of the manure, and the general filthy and dilapidated condition of the pigstyes. In one instance I found pigs kept in a dark and almost unventilated stable which had, apparently, once formed part of a dwelling-house.

C.—General Sanitary Administration.

The Stroud Rural District Council are the successors of the former Stroud Rural Sanitary Authority, though the area of the present Rural District is not co-terminous with that administered by the former body. By two Orders, both dated the 10th November, 1894, the former Urban District of Bisley was merged in the Stroud Rural District, while the parish of Nailsworth, formerly part of the Rural Sanitary District of Stroud, became the Nailsworth Urban District. The rateable value of the Stroud Rural District is £109,813. The balance of outstanding loans is £1,800, an indebtedness which has been incurred on behalf of, and is charged upon, the Stonehouse special drainage area. In respect of the drainage scheme for Rodborough, Thrupp, and Cainscross referred to in the introduction to this report, the Stroud Rural District Council have applied for sanction to borrow a sum of £26,000, and, as has been mentioned, a local inquiry was held on 1st February, 1900, by Colonel Durnford. The matter is at present under consideration by the Board. The assessable value of the district for the "district rate" is said to have been £76,488 in the year 1896. The amount of the rate levied for general expenses in the year ending on the 25th of the present month was $4\frac{1}{4}d.$ and $4\frac{1}{2}d.$ in the £, but I am informed that this is a heavier rate than will probably be necessary in the future as the highways were handed over to the Rural District Council on the 25th March, 1899. The Council consists of 32 members whose meetings are held fortnightly. The meetings of the guardians take place upon the same day. The only standing committee is the "Finance and General Purposes Committee." Various committees, however, have been, and are, appointed from time to time, such as the Painswick Sewage and Water Committee, and the committee for the new sewage scheme for Cainscross, Rodborough, and Thrupp, and such like.

There are no byelaws of any kind at present in force in the district, but I was shown the proof of a new code of regulations, dated January, 1900, in respect of Dairies and Cowsheds; also

an application to borrow £1,000 for the purpose of bringing a supply into the town from the Cherry Spring, 1½ miles distant. Riparian owners and the Stroud Water Company objected, and the Board's sanction was not granted, having regard to the fact that at that time the Stroud Water Company professed themselves ready to give a supply to the place on the statutory terms. The Rural Sanitary Authority, however, were unable to obtain a supply from the Company, though not until November, 1892, did the Water Company finally renounce their claim upon the place. On the 12th April, 1899, the Rural District Council applied for the constitution of a special drainage district at Painswick, but the proposal not being satisfactory to the Board, a fresh scheme for sewerage and water supply was brought forward last December and is now under consideration.

It is imperative that by some means or other the urgently needed water supply be afforded to this locality.

The district is still unprovided with hospital accommodation adequate for the reception of cases of infectious disease, although the need of such an hospital has been repeatedly pointed out by the Medical Officer of Health, and has been emphasized by outbreaks of infectious disease, the extension of which might have been prevented had suitable hospital accommodation been available. In the year 1894, a joint authority, called the Stroud Hospital Board, was formed under a Provisional Order, and this joint board is at present constituted as follows: Three members, besides the chairman, from the Stroud Rural District Council; four members from the Stroud Urban District Council, including the chairman of that body as *ex officio*; two members from the Nailsworth Urban District Council, including the chairman of that body as *ex officio*. The meetings of this Board are held when required. On the 10th of April, 1896, an inquiry was held by the late Dr. Barry into an application by the Stroud Joint Hospital Board, for sanction to borrow £2,000 for the purchase of a site known as "The Achers," situate beside the main road from Stroud to Nailsworth. This site was reported unsuitable by Dr. Barry, and the Board declined to sanction the application.

Since that time, I am informed by the Clerk, the Joint Hospital Board have considered four different sites for the erection of the hospital, and three of these have been, for one reason or another, abandoned. They have now unanimously selected a site in the parish of Cainscross, but, as on previous occasions, so now, there is local opposition, and the Joint Hospital Board anticipate that they will have to obtain compulsory powers to purchase. It appears, indeed, that while the necessity for an hospital is daily becoming more urgent, each parish opposes the establishment of the institution within its borders. The feeling upon this subject is exceedingly strong in the vicinity of Stroud.

In 1896 the Joint Hospital Board erected a temporary iron building, at a cost of £637 11*s*., for the reception of small-pox cases at Stancombe, in the parish of Bisley. No loan was applied for. It consists of two wards, in which 12 patients can

be accommodated. The structure is in good condition, and is looked after by Mr. Bailey, one of the Inspectors of Nuisances.

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There is no disinfector in any of the three districts constituting the Joint Hospital District, although the necessity for this apparatus is pressing. With regard to the disinfection of premises, it would appear that, on receipt of the notification of a case of infectious disease, the Inspector concerned visits as soon as possible the premises in which such case has occurred. He gives such verbal directions as he thinks necessary to secure the isolation of the infected person, and leaves with the householder a printed code of the "Rules to be observed for Disinfection," &c., a copy of which will be found in the Appendix. The subsequent disinfection of premises is carried out under the personal superintendence of the Inspector of Nuisances whenever such superintendence is thought advisable, and is said to be generally by sulphur fumigation, or by spraying with Sanitas or other liquid "disinfectant."

Conclusion.

As the result of my inspection, I incline to the view that the Stroud Rural District Council cannot be charged with having been altogether unmindful of their duty as regards the sanitary needs of their district, especially in view of the extensive sewerage and drainage scheme that has now been formulated, which is referred to on p. 133. But on the other hand, a perusal of the facts set forth in this report sufficiently indicates that in many directions the district requires intelligent and sustained effort to remove serious danger to health. The provision of a wholesome water supply and a system of sewerage and drainage for the town of Painswick should be no longer delayed. Throughout the district a careful examination should be made of the local water supplies, with a view to forbid the use of those that are a danger to the consumer. The Council should themselves undertake or contract for the public scavenging in many of the more populous centres, such as Painswick, Rodborough, and Minchinhampton.

The Council would also be well advised to obtain urban powers in respect of several of the larger villages, in order that byelaws may be framed in respect of nuisances, slaughter-houses, &c.*

Lastly, the provision of a hospital for infectious diseases, together with a suitable disinfector, should no longer be postponed.

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* *Note.*—As this report goes to press a letter from the Clerk, Mr. Winterbotham, informs me that the Rural District Council have now applied to the Local Government Board for urban powers, under section 44 of the Public Health Act, 1875, to enable them to make byelaws as to nuisances in respect of the following contributory places:—Parishes of Cainscross, Rodborough, Stonehouse, and Thrupp, and the Painswick special Drainage Area when constituted. In respect of these places they have also decided to make byelaws as to streets and buildings.

NAILSWORTH URBAN DISTRICT.

A.—Topographical and General.

The Nailsworth Urban District has existed as an independent Sanitary Area since November 10th, 1894, when by an Order of the Board the parish of Nailsworth, formerly part of the Rural Sanitary District of Stroud, became an Urban District. It is bounded on the north and south by the Stroud Rural District; on the east by the Tetbury Rural District, and on the west by the Rural District of Dursley. It is about 2¼ miles long and of an average width of a mile. Its area is a little over 1,622 acres. Its estimated population is 3,200; the number of inhabited houses is said to be 761. Near the centre of the district is situated the little market town of Nailsworth which lies in a hollow at the point of juncture of four valleys. From the three smallest of these valleys three streamlets descend to meet in the town, and flow as one stream in a northerly direction along the fourth valley, which may be hereinafter referred to as the Nailsworth Valley—receiving on the way several little tributaries—to fall into the River Frome at Dudbridge, in the Stroud Rural District. In the neighbourhood of the town, and closely connected with it, are the small villages or hamlets of Newmarket, Forest Green, Watledge, Harley Wood, and part of the hamlet of Shortwood. The Town of Nailsworth itself is, I am informed, slowly but steadily growing. The district possesses numerous industries, among which are factories of hosiery, shoddy, and leather board. There are also breweries, brass foundries, corn mills, a large bacon factory, and borax works, the last mentioned lying partly in Nailsworth Urban and partly in the Stroud Rural District. In these various factories or in petty trades and in the pursuit of agriculture in various forms the population is engaged.

The geological formation hereabouts is the same as in the Stroud Rural District. The Town of Nailsworth rests partly on the Clay and partly on the Midford or Inferior Oolite sands.

B.—General Sanitary Circumstances.

Roads, Dwellings, and House Accommodation.—There are said to be about 14 miles of dedicated roads in the urban district, and they are generally in good condition. I heard of no undedicated roads. Practically all the older houses are of stone, roofed with stone tiles; such houses occur irregularly in groups. In addition there are a number of houses built of brick and mostly placed in rows; these are also for the most part of sufficiently solid construction. There are a few back-to-back houses of old date; back-to-earth houses are also not uncommon. In the town of Nailsworth curtilages are frequently scanty, nor are these spaces well kept. Paving is rarely seen in back yards or round the houses; where existing, it is of a faulty and irregular description. With few exceptions houses seem to be provided with eave-spouting of some sort, though it was

frequently noticed to be defective. Down-pipes are often so arranged as to provide a supply of soft water collected in butts; but where the latter have been removed, the water is allowed to flow upon the ground beside the dwelling-house and to soak into the foundations.

In the outlying portions of the district garden ground seems for the most part sufficient; though in the case of cottages situated on the steep slopes and with a water supply drawn from shallow wells, the disposal of excreta in such garden ground needs to be carefully watched.

Water Supply.—The only public water service in the district is that afforded by the Stroud Water Company already referred to. I learn that 148 houses in the Town of Nailsworth were, at time of my visit, supplied with water from this source.

As regards the remainder of the houses in the district, their inhabitants obtain water from wells or springs. The district, especially on the south-west side, would seem to contain abundant natural water supplies, for a great portion of the year at any rate; but in dry seasons there is said to be some scarcity. In some instances, too, water supplies, reputedly abundant and of good quality, are situated upon private grounds. In the hamlet of Newmarket, for instance, nearly all the inhabitants have to obtain their supply of drinking water from the premises of a large bacon factory, to which they are allowed access. But should this permission be withdrawn, they would, as things now are, be compelled to fetch water from the bottom of a steep hill nearly one-third of a mile distant. Meanwhile, in other parts of the area, water sufficient in quantity for a large portion of the district is flowing away.

At Newmarket and elsewhere I saw wells the water in which is avoided, as it is generally reputed to be bad.

There is a drinking fountain in the town supplied from a spring rising in the fields near Springhill, whence the water is conveyed in pipes. It is said to have been "tested" by the Medical Officer of Health and is regarded as of good quality.

Sewerage and Drainage.—There is no regular and definite system of sewerage in the district. In the town of Nailsworth, indeed, various short sections of so-called "sewers" exist, but there is no known plan of them as far as I could ascertain. The older "sewers" are, judging from one opened in my presence, mere rough slab-stone drains; those more recently laid are said to be glazed and socketed pipes. All of them appear to discharge into the stream flowing through the town, or into an intervening pond known as Day's Mill Pond.

My attention was especially drawn to the state of this stream by local complaints. At the time of my visit, although this and all the water-courses in the district were in flood, the banks of the urban portion of this stream, and also the pond, were in a very foul condition. In the pond itself quantities of filth

were seen, and excrement was distinctly visible. Certain persons, compelled to pursue their avocations hereabouts, complained strongly of the stench emanating from it, which, at times in the summer, they alleged was such as to cause actual nausea. In their course to the stream above referred to, and which may be regarded as the main sewer of the district, some of the so-called "sewers" pass beneath dwelling-houses. At one of my visits a householder called my attention to an instance of this. He had himself become aware of it owing to a foul smell rising through the floor; investigation made by him revealed a rough stone public drain just below the floor of his "living" room. There is no doubt that connection to these old drains of an increasing number of water-closets has created a nuisance which is likely to become intolerable. House slops from all dwellings near the streams are got rid of by passing them into water-courses wherever possible.

Excrement and Refuse Disposal.—Save where excreta are got rid of by means of the so-called sewers above referred to, these matters are allowed either to fall from privies directly into the streams or the privy contents are disposed of upon gardens and agricultural land. The first-named method of disposal is that employed, as in the Stroud Rural District, by riparian householders. Privy vaults, which are very numerous, are in some instances dry-bricked, in others mere excavations in the ground. As already stated, the garden ground available for excrement disposal is not always suitable either in extent or situation.

The Urban District Council have entered into a contract for the removal of house refuse. In the central or town portion of the district the contractor is required to remove refuse on two days in each week before ten o'clock in the morning, and as regards that portion of the rest of the district lying within half-a-mile of Nailsworth Church before noon. Notwithstanding this arrangement, an undue quantity of house refuse was observed lying about within the special area thus dealt with.

In the outlying parts of the district inhabitants dispose of house refuse by casting it anywhere they can. I saw no ashpits in any part of the district.

No register is kept of *Slaughter-Houses*. As regards those visited by me, the floors were irregular and defective, allowing the collection and soakage of blood-stained liquid between the paving stones or bricks. In two cases the fasting-house was not screened from the slaughtering-place. The arrangements for the disposal of blood are generally unsatisfactory; there is no doubt that blood, filth, and refuse of all kinds from these places reach the stream.

Dairies, Cowsheds, and Milkshops.—These are likewise unregistered. Those visited by me have need of supervision. The keeping of clothes and articles of food in places where milk is stored should be prohibited, and care should be taken that such places are properly ventilated.

I heard of no *Common Lodging-Houses* in the district, nor did I hear of any offensive trades, but as in the Rural District of Stroud so in the Town of Nailsworth, nuisance is caused by pig-keeping, and by the accumulations of manure.

C.—General Sanitary Administration.

The Urban District Council of Nailsworth consists of nine members, whose meetings are held once a month, exclusive of their annual meeting in the month of April. I am informed that the following committees have been constituted: Highways and Works, Finance, Special Area Lighting and Scavenging and Street Watering, Brooks Scavenging, and an Educational Committee under the Blind and Deaf Children Act, 1893. Sanitary matters are dealt with by the Special Area Committee and by the Brooks Scavenging Committee.

The present General District Rate is 5*d*. In the special area above referred to there is an additional rate of 10*d*. for lighting, scavenging, and street watering. In general, the character of the administration falls short of what might have been expected in an urban district created within the last few years.

There are no byelaws whatever in force in the district; nor are there any regulations as regards dairies, cowsheds, and milkshops, or other matters.

The following voluntary Acts have been adopted in the district: The Infectious Disease (Notification) Act, 1889, and the Infectious Disease (Prevention) Act, 1890, both of which came into force on the 20th August, 1896; Parts II. and III. of the Public Health Acts Amendment Act, 1890, came into force on the 23rd September, 1895.

The Medical Officer of Health is Dr. Thomas Partridge, who receives a salary of £20—half of it being repayable from county funds. The other offices held and the work done by this gentleman have already been referred to in the previous portion of this report dealing with Stroud Rural District. There also will be found recorded similar facts as to the Inspector of Nuisances, Mr. John Hall, who for his services in this district receives a salary of £12 10*s*. He presents his report-book at each meeting of the Urban District Council, and the various items having been considered by the Council, are initialled by the chairman.

There is neither isolation hospital nor disinfecting apparatus in the district. As regards small-pox the Nailsworth Urban District has a share in the Joint Hospital near Stroud, and will have a share in a hospital for infectious diseases when such shall have been erected by the Joint Hospital Board.

The action of the Urban District Council as regards minor nuisances is on the whole fairly prompt, but as regards the

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now pressing question of the provision of a sewerage and drainage scheme their attitude is set forth in the following memorandum, which was handed to me as expressing their views.

MEMORANDUM.

URBAN DISTRICT COUNCIL OF NAILSWORTH.

General view of the Council on the matter of Drainage, &c.

That the amount of sewage in the river at Nailsworth is so small in proportion to the volume of water, that it becomes so dispersed and disintegrated before it has been carried any distance as to be no nuisance or danger to any persons or properties further down the valley. That it is in no way a danger to the health of the Nailsworth Urban District as the scavenging of the streams and ponds is carefully attended to every year by the Council and the mill-owners. That until the population of the district (about 3,200) (rateable value £10,000) has considerably increased there will be no immediate necessity for any general sewerage scheme, and that until the Royal Commission on Sewage Disposal (now sitting) has made its Report, and the experimental systems of drainage at Cainscross and Rodborough have been tried, it is impossible to decide which particular system would be best adapted for the Nailsworth District, which is in many respects a peculiar one in general configuration and position. That the the Nailsworth Urban Council have the question of byelaws which will give them increased powers in dealing with pigstyes, drains, and nuisances before them for consideration, and hope to formulate such byelaws for approval of the Local Government Board shortly.

(Signed) A. E. SMITH,
Clerk.

GENERAL REMARKS ON THE POLLUTION OF STREAMS IN BOTH DISTRICTS.

From the foregoing remarks, and from an examination of the accompanying map, it will be apparent that the Rural District of Stroud and the Urban District of Nailsworth are of a very hilly nature, and that the bottoms of the valleys are occupied by streams, tributaries of the River Frome which, rising at Climperwell in the parish of Brimpsfield, flows down the Chalford Valley across the Stroud Rural District and falls into the Severn at Framilode. Formerly the Frome abounded in trout and other fish, and trout are still found above Brimscombe, but from that point downwards fish have, I am informed, totally disappeared.

The contamination of these streams, especially the Frome, is derived from two sources, viz., first, the refuse chemical matters from the factories on the banks, and secondly, the sewage matters discharged into them from a large number of privies and drains. Of these the chemical matters are by far the more prominent. Indeed, speaking generally, they are in such large quantity as to completely obscure the presence of sewage matter. On the various occasions when I saw the River Frome during the course of my inspection, I found that in the vicinity of Stroud its waters were of various conspicuous colours—deep red, blue, black, or yellow, according to the nature of the dye refuse, potassium bichromate, alizarine, or such like, discharged from the factories near by. Vitriol also, as well as the sulphates of iron and copper, get access to the stream. At every factory or

"works" which I visited in the neighbourhood I found, without exception, that the privies intended for the use of the work-people were placed over the streams. The great number of sewer and drain pipes which discharge into the river have already been mentioned. Having regard to these facts, the rivers and watercourses of the two districts of Nailsworth and Stroud may be regarded as, in the present arrangement of things, the common sewers of the district. The arrangement for cleansing (locally known as "mudding") the beds of the two principal streams in these districts, viz., the River Frome and its Nailsworth tributary, require a passing reference. In both districts the streams are cleansed or "mudded" annually, and that in summer; but while in the Urban District of Nailsworth this "mudding" is said to be carried out at the expense and under the direction of the District Council, by arrangement with the mill-owners, in the Rural District of Stroud the operation is said to be performed by the mill-owners' own agency and at their own cost.

In both districts the method of cleansing appears to be the same. The work is begun at the mill situated highest up along the stream. Each mill-owner in turn then cleanses the portion of the stream between his mill and that next below. The filth detached from the banks is not removed from the stream bed, but is merely loosened and allowed to be carried down by the stream.

In the course of this operation great nuisance is created, for there can be no doubt that both the streams in the Chalford and the Nailsworth Valleys are in a very foul condition. From a residential point of view this must be decidedly detrimental to both districts, and if allowed to continue, a diminution in the value of property is to be feared. I found that mill-owners, while admitting the foul state of the streams and the cause thereof, maintained that, if they were debarred from discharging their trade refuse into the water courses and were compelled to provide themselves with special drainage, the closure of their mills would be inevitable.

Conclusion.

The Nailsworth Urban District Council would appear desirous of undertaking as little sanitary work as possible. The Council should not seek to shirk their responsibility as regards the sewerage and drainage of the town of Nailsworth, such responsibility being the more evident since the surrounding Rural District of Stroud has already given proof of its good intentions as regards a like necessity. Meanwhile Nailsworth would do well to adopt without delay a code of byelaws, and to this end the Council should study the Board's model series.

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[COPY.]

Wickwar, Gloucestershire,
24th March, 1898.

F. Graham Ansell, F.C.S.,
Analytical Chemist and Electrical Engineer.

The Secretary,
The Stroud Water Co, Stroud, Gloucestershire,

Dear Sir,—I have made a very careful and full analysis of the sample of water you handed me from your mains on the 16th instant, and find it a very pure, wholesome water, admirably suited for all domestic purposes.

It contains only ·01 part per million of free ammonia, and only ·04 part of albuminoid ammonia. The chlorine is only ·98 grain per gallon. The total mineral matter is 6·3 grains per gallon, and consists of carbonate of lime, 2·1 grains; sulphate of magnesia, 2·6 grains; and chloride of sodium, 1·6 grain. These figures are all very low and therefore satisfactory. There is not a trace of any poisonous metal such as lead or copper. I found no bacteria, animalculæ, or spores of any kind, and the water must be pronounced quite free from all suspicion of sewage or other contamination.

The temporary hardness of this water is so low that it is all but non-existent, and compares most favourably with that supplied by other companies. It would be a very excellent water for steam boilers as it would require so very little softening, and, besides the small amount of carbonate of lime, there is no other salt likely to give any trouble.

I am, dear Sir,
Yours very faithfully,
(Signed) F. GRAHAM ANSELL.

P.S.—The temporary soap hardness is	2·1
„ permanent „ „	3·3
Total hardness	5·4

F. G. A.

[COPY.]

City and County Laboratory,
Belmont, Brunswick Road, Gloucester,
April 13th, 1898.

Sample of water received from G. P. Milnes, Esq., Surveyor, on behalf of Stroud Urban District Council, per G.W.R., April 6th, 1878:—

	Parts per 100,000.
Total solid matter	20
Combined chlorine	2
Nitrates	Absent.
Mineral ammonia	·002
Organic	·002
Oxygen required for combustion of organic matter ...	·011
Hardness, permanent	2·72 degrees.
„ temporary	2·56 „
Total	5·28 „

Micro-organisms, 15 per cubic centimetre, all harmless.

The water to which the above analysis refers is exceedingly pure, and gives no evidence of sewage or other pollution.

(Signed) GEORGE EMBREY, F.C.S.,
Public Analyst

No. 12.

REPORT upon EPIDEMIC ENTERIC FEVER in NUNEATON and CHILVERS COTON URBAN DISTRICT; by DR. R. W. JOHNSTONE.

APP. A, No. 12.

On epidemic enteric fever in Nuneaton and Chilvers Coton Urban District; by Dr. R. W. Johnstone.

On September 7th, 1899, the Local Government Board received information, in accordance with the requirements of their General Order, from Mr. E. Peacock, Medical Officer of Health of the Urban District of Nuneaton and Chilvers Coton, of the epidemic prevalence of enteric fever in the district. Reports of the continuance of this disease were received from the same source on September 23rd, October 18th, and November 13th of 1899.

In view of these reports I received instructions from the Local Government Board to make inquiry into the circumstances attending the outbreak, and I accordingly visited the locality in January, 1900, and subsequently.

Brief Description of the Urban District.

The district has an area of 10,598 acres. It is bounded on the north by the Atherstone Rural and the Nuneaton Rural Districts, on the east by the Hinckley Rural and Urban Districts, on the south by the Bulkington Urban and the Foleshill Rural Districts, and on the west by the Nuneaton Rural District.

The river Anker, which is here little more than a brook, runs by a circuitous route in a north-westerly direction through the north-east corner of the district. Shortly after traversing the town of Nuneaton it receives the effluent from the urban district sewage works.

The main line of the London and North-Western Railway Company, here running north-west and south-east, crosses at Nuneaton the railway connecting Birmingham and Leicester, running east and west. The town is also connected by rail with Coventry to the south-west and with Burton and Coalville to the north, and is thus a considerable railway centre.

The country is gently undulating, but rises gradually to the north and west, eventually attaining an altitude of about 480 feet above Ordnance Datum, or, roughly, 200 feet above the town of Nuneaton. Outside the town and its environs the country is mainly under grass and is very sparsely inhabited.

Geologically, the whole district is on Red Marl.

At the census of 1891 the population was 15,000, and the population, locally estimated to the middle of 1899, was 18,346. In December, 1899, however, a census of the whole urban district was taken by means of the school attendance officers and the rate collectors, in connection with the formation of a school board, and

the population was then returned at 22,856.* The assessable value is £90,000.

The majority of the inhabitants belong to the artisan and working class. In the town of Nuneaton hat factories, plush factories, wool-scourers and fellmongers employ many hands. Certain of these industries are largely carried on by female labour. In the more rural localities many persons find employment in quarries, coal mines, and in brick and tile works.

Sanitary Conditions.

Streets and Dwellings.—The streets throughout the district are macadamised, and the roadways, as a rule, are in satisfactory condition. Portions of the town footways have been flagged by the Urban District Council within the last few years, but there is still room for improvement in this respect.

There is in the town a good deal of overcrowding of buildings upon area, notably in the courts behind the houses on both sides of Abbey Street. The courts are reached from the main street by narrow passages, generally inaccessible to carts, and consist of a number of closely-packed dwellings, many of which are not well fitted for habitation. Few of these dwellings have either sinks or wash-houses, the windows generally are not constructed to open, the walls are often damp and dirty, the roofs defective, and the ceilings dilapidated; garden space is absent or deficient. Abbey Street will be referred to later in connection with the outbreak of enteric fever; but it must not be supposed that these courts exist only off Abbey Street. They are found throughout the urban part of the district, though nowhere, perhaps, with so many and so conspicuous defects. The older dwellings throughout the district suffer, with few exceptions, from damp. They are without damp-proof courses; eave-spouting and down-spouting are frequently defective, and the roofs sometimes admit rain. These defective properties are often owned separately by small freeholders who are unwilling to undertake the necessary repairs. Yards are generally paved with uncemented brick or with cobbles, but in some instances they are unpaved.

Excrement and refuse disposal.—House refuse and excrement are generally disposed of by means of midden privies. In some cases water-closets have been erected, but the majority of the inhabitants depend upon the midden privy, which is still erected in connection with new buildings, even where sewers are available. The receptacles of privy middens are not always protected from the rain, and are often sunk several feet below the surrounding ground level. During my inspection their contents were generally found to be moist and offensive. They are built usually of brick and mortar, and are sometimes of considerable cubic

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* I have reason to believe that this local census is accurate, and accordingly the tables dealing with estimated populations between the years 1891-99 in this report have been based on the 1891 census figures in their relation to the figures of the local census of 1899.

capacity.* These middens, when full, are emptied by the urban district council, sometimes not more often than four times a year. Where they are not lined with impervious material, their contents soak into and pollute the surrounding soil; and when they are situated, as is often the case, in courts inaccessible to carts, the process of emptying them causes much nuisance to the inhabitants in the vicinity.

The privy or water-closet accommodation is not in all cases adequate for the number of persons for whom it is provided.

Slop water is usually disposed of by emptying it into gullies at the doors of the houses, whence it is carried to the sewers by drains. These drains are often untrapped, old, and leaky, so that the surrounding soil becomes polluted with organic filth or possibly with specific matter contained in the slop water. In addition, a drain of this sort not unfrequently passes close to the mouth of a well serving one or more groups of houses, sometimes within a foot or less. There is little doubt that to this cause may be attributed the organic pollution of many wells, to which reference will be made when the subject of water supply comes to be considered. Cesspools are in use in the more rural parts of the district, and have been complained of as causing nuisance.

As regards the disposal of night soil, considerable difficulty has been experienced by the Council. The refuse and excrement are carted to tips, and removed thence for manuring farms. The farmers are not always willing to take the material, and it seems possible that more active measures in the substitution of water closets for privies will shortly be called for, if only on the ground of economy.

Sewers and Sewage disposal.—The urban portion of the district was sewered about 30 years ago. No plans of the sewers could be produced, and, owing to the height of the ground water, at the time of my visit inspection was difficult. I was compelled therefore to rely on the description of the sewers furnished me by Mr. Pickering, the Council's Surveyor, rather than on personal observation. There is a separate system for surface water which discharges direct into the River Anker. The sewers proper are generally constructed of brick or of glazed earthenware pipes jointed with clay. They are not laid in straight lines, but follow the curve of the road. As result, the risks of leakage and of obstruction are much increased; while the inspection of sewers, the means for which are at present quite inadequate, is rendered more difficult. A considerable number of ventilating shafts have recently been erected in connexion with the sewers through the efforts of the Medical Officer of Health.

The older sewers are throughout leaky. By way of leaks they drain the soil in their neighbourhood and hence, even in moderate rains, they convey large quantities of storm-water and soil water

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* One was observed of a capacity of about 150 cubic feet, partly full of liquid and offensive filth, unprotected from the rain, and within 15 feet of the doors and windows of a dwelling.

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to the outfall works. Occasionally sewage escapes from the sewers into the streets after heavy rainfall.

The sewerage system discharges at the Council's sewage works, where the sewage is pumped and then treated partly by means of bacterial filter beds and partly by the alumino-ferric process, the effluent in each instance ultimately discharging into the River Anker. In summer, when the river runs almost dry, considerable nuisance is caused by secondary decomposition of the effluent. On the other hand, when the river is running full, the end of the outfall sewer is submerged, and river water reaches the pumping well. Pumping has usually to be stopped on this account once or twice a year: the sewers then become waterlogged until a head of 7 or 8 ft. is attained at the outfall, when their contents begin to discharge direct into the river.

Water supply is largely from shallow wells, though of late years many houses have been supplied from the public water supply belonging to the Council. Water is found throughout the town of Nuneaton at a depth of from 4 to 10 feet below the surface. Of 87 samples of water from various wells in the Urban District, which were recently submitted to chemical analysis by the County Analyst (Dr. Bostock Hill), no less than 76 were pronounced unfit for drinking purposes on account of organic pollution. Allusion has above been made to the frequency with which old and leaky slop-water drains pass close to the mouths of wells. In addition to this possible cause of direct pollution of well water, there is good ground for suspecting that leaky privy pits and leaky sewers often pollute the ground water in their vicinity. In this way particular wells or perhaps a series of wells are liable to be deleteriously affected.

PUBLIC WATER SERVICE.

The public water service belongs to the Urban District Council, and is derived from four sources which on the average yield the following daily volumes respectively:—

1. Robinson's End, Stockingford ...	60,000	gallons in 24 hours.
2. Tunnel Colliery	30,000	,, ,,
3. Midland Quarry	35,000	,, ,,
4. Stanley's Boring...	250,000	,, ,,

1. Stockingford Wells:—The service reservoir for the whole district is at Robinson's End, Stockingford, about 2½ miles west from Nuneaton Town, and 465 feet above Ordnance Datum. The reservoir is covered in, and sand filter beds are in course of construction in connection therewith. At the time of my first visit (January, 1900) they were expected to be in use within a few days. There are here two deep wells, 112 feet and 220 feet in depth respectively, from which water is raised to the service reservoir by means of steam pumps.

2. The Tunnel Colliery:—This supply is obtained from water bearing strata, which are traversed by the colliery shaft at a

depth of 480 feet. The shaft is sheathed with iron where it pierces these strata, thus excluding the water, which is raised by steam pump to the service reservoir at Robinson's End, about a mile to the east.

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3. The Midland Quarry :—This is on the outskirts of the town of Nuneaton, and the water obtained from it is primarily for the use of the Midland Railway Company. By arrangement, spare water not needed by the Company has been pumped into the town mains. As, however, this necessitated pumping against a pressure of 200 feet, it has now been discontinued and spare water diverted into the canal. The connection with the town mains, however, still exists, and as this quarry supply appeared liable to contamination from workmen and otherwise, particular inquiry was made as to its use in the town. I was, however, informed by the engine driver in charge of the cocks controlling the connection that for two years past no water from this source had reached the town mains.

4. Stanley's Boring or Whittleford pumping station :—This is about two miles west of the town and about a mile north-east of Robinson's End. The boring was originally made for coal mining purposes; but at a depth of 360 feet water was struck in such quantities that the shaft was abandoned. The water is now raised to the service reservoir by steam pumps, and the supply is practically unlimited, no amount of pumping hitherto practised having made any appreciable difference in the water level. It is intended in future that this supply, together with that from the Tunnel Colliery, shall alone be used, the Stockingford supply being discarded for economic reasons.

The following table shows some of the most recent chemical analyses of the public water supply by Dr. Bostock Hill. The results are expresssed in parts per 100,000 :—

Source of Sample.	Date of Analysis. 1899.	Total Solids.	Free Ammonia.	Organic Ammonia.	Nitrogen as Nitrites and Nitrates.	Chlorine.	Oxygen absorbed in 4 hours.	Hardness.		
								Temporary.	Permanent.	Total.
Tap water (a) ..	Aug. 31	32·0	·001	·004	traces	2·1	0	18·16	10·58	28·74
Midland Railway Quarry (a).	Sept. 4	40·0	·001	·004	·33	2·5	0	14·94	12·48	27·44
Stanley's Boring (b).	Sept. 4	34·0	·006	·006	traces	2·1	0	12·54	9·75	22·29
Stanley's Boring (c).	Sept 10	34·0	·002	·002	traces	2·1	·017	14·26	10·86	25·12
The Tunnel (c) ..	Sept. 9	40·0	·004	·004	0	1·9	0	—	—	23·92
Robinson's End Wells.	Sept. 9	34·0	·004	·004	0	2·3	0	—	—	23·92

(a) Slightly turbid.
(b) Turbid.
(c) Slightly turbid, yellow deposit. Chiefly oxide of iron, the supernatant fluid clear after standing, and practically free from iron.

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It will be seen that the analyst reporting on the samples refers to turbidity and yellow deposit due principally to oxide of iron. Unfortunately for the popularity and the more general use of water from the public mains, owing to its colour strong prejudice exists against using it for drinking purposes. At the time of my visit, samples of tap water taken for me were perfectly clear; but I was informed that at times it ran yellow to opacity. Doubtless the filter beds will bring about marked improvement in these respects.

SOME MORTALITY STATISTICS.

TABLE I.—Showing per 1,000 of the estimated population, the death-rate from all causes, the infantile death-rate, the death-rate from DIARRHŒA and DYSENTERY, and the death-rate from ENTERIC FEVER in the NUNEATON and CHILVERS COTON URBAN DISTRICT during the years 1891–1899 inclusive, with the corresponding figures for ENGLAND and WALES during the same year.

—		Death-rate per 1,000 from all causes.		Infantile death-rate per 1,000 born.		Death-rate per 1,000 from Diarrhœa and Dysentery.		Death-rate per 1,000 from Enteric Fever.	
Year.	Estimated population of Urban District.	Urban District.	England and Wales.	Urban District.	England and Wales.	Urban District.	England and Wales.	Urban District.	England and Wales.
1891	15,297	18·2	20·2	134	149	·196	·469	·588	·168
1892	16,084	17·9	19·0	167	148	·248	·505	·310	·137
1893	16,912	12·4	19·2	171	159	1·242	·954	·118	·229
1894	17,783	16·2	16·6	129	137	·450	·350	·168	·159
1895	18,698	18·5	18·7	161	161	·428	·874	·428	·175
1896	19,661	16·8	17·1	143	148	·662	·546	·203	·166
1897	20,673	17·8	17·4	184	156	1·598	·840	·145	·156
1898	21,737	19·9	17·6	191	160	1·613	·923	·368	·182
1899	22,856	17·09	*18·3	166	*163	1·137	*·98	·700	†

* From Registrar General's quarterly return (4th quarter).
† Figures not yet available.

The death-rate from all causes has generally been below that of England and Wales, but shows a tendency to rise in later years. In the years 1893, 1897, and 1898 the infantile death-rate was high. This was no doubt due to infantile diarrhœa.

ENTERIC FEVER.

Enteric Fever in Nuneaton and Chilvers Coton Urban District prior to 1899.—During the years for which the figures are available for comparison, in only two years, 1893 and 1897, was the enteric fever death-rate of the Urban District below that of

England and Wales. In each of the other years the rate was higher, and in some cases considerably so. It would appear that since 1891, when the disease approached epidemic proportions, enteric fever has been endemic in Nuneaton and Chilvers Coton Urban District, although previous to 1891 there does not seem to have been any exceptional enteric fever mortality so far as may be judged from the figures of the following short table :—

TABLE II.—Showing the mean death-rate from ENTERIC FEVER per 1,000 persons living in NUNEATON REGISTRATION* DISTRICT and in ENGLAND and WALES during successive 10-year periods.

Period of 10 years.	Mean Population in Nuneaton Registration* District.	Death-rate per 1,000 from Enteric Fever.	
		Nuneaton Registration District.	England and Wales.
1871–80	13,067	·37	·32
1881–90	15,563	·20	·20

* Nuneaton Registration District includes the Urban District of Nuneaton and Chilvers Coton.

From the next Table it will be seen that previous to 1899 the enteric fever attack rate of 1891 was the most severe, though the fever death-rate of that year was less than in 1899.

TABLE III.—Showing year by year for the period 1891–99 the number of notifications of ENTERIC FEVER, and the ENTERIC FEVER attack rate per 1,000 persons living in the URBAN DISTRICT of NUNEATON and CHILVERS COTON; with the number of deaths, and the death-rate yearly from the same cause.

Year.	Estimated Population.	Enteric Fever.			
		Notifi-cations.	Attack-rate per 1,000.	Number of deaths.	Death-rate per 1,000.
1891	15,297	82	5·4	9	·588
1892	16,084	31	1·9	5	·310
1893	16,912	19	1·1	2	·118
1894	17,783	9	0·5	3	·168
1895	18,698	14	0·7	8	·428
1896	19,661	10	0·5	4	·203
1897	20,673	21	1·0	3	·145
1898	21,737	28	1·3	8	·368
1899	22,856	114	5·0	16	·700

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Enteric Fever in Nuneaton and Chilvers Coton Urban District during 1899.—During the year cases were notified as follows:—

TABLE IV.

Enteric Fever.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total in 1899.
Cases notified ..	—	2	—	—	2	—	1	22	40	28	15	4	114
Of which were fatal.	—	1	—	—	1	—	—	5	4	3	2	—	16
Houses newly invaded during each month.	—	2	—	—	2	—	1	18	32	19	11	3	88

Thus for the first seven months of the year there was no marked prevalence of enteric fever. In July a case was notified from Abbey Street on the 10th, and the first notification in August was received on the 1st.

The notifications during the last five months of 1899 week by week were as follows:—

TABLE V.

——	Cases notified.	Houses newly invaded.
Week ending August 5	2	1
" " " 12	1	1
" " " 19	2	2
" " " 26	9	7
" " September 2	14	9
" " " 9	11	8
" " " 16	7	6
" " " 23	2	2
" " " 30	15	13
" " October 7	9	6
" " " 14	9	7
" " " 21	6	2
" " " 28	3	3
" " November 4	6	5
" " " 11	1	1
" " " 18	4	3
" " " 25	2	2
" " December 2	5	4
" " " 9	—	—
" " " 16	1	1
" " " 23	—	—
" " " 30	—	—
22 weeks ending December 30, 1899	109	83

During the course of my inspection, as is usual in similar epidemics, cases were heard of which had escaped notification.

There does not appear to have been any definite sudden outburst of enteric fever, the notifications gradually increasing in number in August to attain their highest in September, and decreasing again in October and November, until in December they ceased.

Of the 109 cases which were notified on and after August 1st, 31 were removed to the isolation hospital, Turtle Hill, 16 to the Cottage Hospital, and one to the workhouse. The remainder were treated at their homes.

The age distribution of 114 cases occurring during 1899 was as follows:—

TABLE VI.

Age.	0-	5-	10-	15-	25-	35 and upwards.	Total.
Notified cases of enteric fever.	2	14	17	49	15	17	114
Of which were fatal	1	2	0	7	2	4	16

The principal incidence, it will be seen, was upon young adults.

Localities invaded.—In two localities outside the town of Nuneaton there was definite aggregation of cases, namely, in Chapel End and in Griff; but the bulk of the cases occurred in the town itself.

Chapel End is a village on the north-western border of the urban district, the larger part of it being in the Atherstone Rural District where it is nearly continuous with Hartshill. Six cases here were notified to the Medical Officer of Health of the Nuneaton and Chilvers Coton Urban District Council. The first case notified was on October 7th, a workman in the Tunnel Colliery; two other cases followed on October 11th and 12th, both workmen in the same pit. These, with other cases in Chapel End, are to be regarded as part of an outbreak which occurred in Atherstone Rural District during August, September and October, 1899.

Eight cases were notified in Griff village and its neighbourhood. Griff is on the southern border of the urban district, and is continuous with Colleycroft in the Foleshill Rural District. There was a serious outbreak of enteric fever in Colleycroft and Bedworth during the summer of 1899, and the Griff cases were directly connected with it.

Nuneaton Town.—About 80 per cent. of the cases of fever which occurred in 1899 were notified from the town of Nuneaton within an area bounded on the south-east by the London and

North-Western Railway (Coventry and Nuneaton branch), on the north and east by the Midland (Nuneaton to Birmingham) Railway, and on the west by the Coventry Canal. The cases notified from this area, which I will term the "infected area," were 90 per cent. of the total number of cases notified from Nuneaton town during 1899.

The infected area, which embraces some 2,562 houses, stands on comparatively level ground, rising slightly towards the north; it also comprises the valley of the Anker, a narrow depression not built upon.

Nearly half the cases which occurred in the infected area were notified from Abbey Street, a wide thoroughfare bordered on either side by shops and small dwelling-houses, between which narrow passages lead into squalid courts.

As to the Cause of the Fever.

Inquiry was made as to the *occupations* of persons attacked, and in most cases particulars were obtained. The only instances, however, in which a number of persons working in the same place were attacked, were at Griff Colliery and at the Tunnel Colliery. In neither instance was the number of attacks sufficiently large to enable deductions of any value to be drawn, and in both cases, as before observed, the attacks are to be regarded as connected rather with the outbreaks of enteric fever in Foleshill and Atherstone Rural Districts than with that under discussion.

As to *milk supply*, the information obtained did not indicate exceptional incidence upon persons procuring their milk from any one dairy or farm. No inquiry as to other articles of food was deemed necessary.

The question as to the relation of *local pollution of soil* to the prevalence of enteric fever in Nuneaton during 1899 was considered in some detail. Pollution of the soil existed in greater or less degree throughout the inhabited portion of the urban district, owing principally to leaky sewers, leaky privy middens, and to slop waters thrown into defective drains. Opportunities for specific infection of polluted soil undoubtedly have occurred with frequency during the past nine years. Now, if the specific organism of enteric fever once deposited in polluted soil can remain dormant there until aroused to activity by favouring conditions, repeated incidence in Nuneaton of fever upon some particular house or group of houses was perhaps to be expected, especially in places where exceptional opportunity for specific infection was known to have occurred. Inquiry as to the situation of invaded houses in each of several years before 1899 gave, however, no indication that there had been recurrence, year after year, of enteric fever in any particular house or group of houses. But when inquiry was made for recurrence of cases in

particular localities during the epidemic of 1899, the following facts appeared:—Five cases of enteric fever were notified in the district before August 1st. In the case A (February) the patient was early removed to hospital, and the house and drains, as far as could be seen, were in good condition. In the remaining four cases, the patients were nursed at home. In the case B (February), there was a hand-flushed water closet; the house and drains, however, were in good repair. In case C (May) the house was modern and the drains apparently sound. In case D (May) the house was old and in poor condition, there was a privy midden but no defect was noted in the drains. In case E (July 10th) the house was in very bad condition, the drain untrapped and leaky, and there was a privy midden in bad condition. The first three cases were not followed by further cases in their vicinity; the fourth case was followed by one case, in November in the house immediately opposite at the other side of the road. Case E occurred in Abbey Street in July, and round it, as centre, within the following three months, were grouped upwards of 30 cases. None of these were more than 100 yards distant, and they increased in number as the common centre was approached. The first case to occur near the dwelling of case E was notified on August 21st, in a house immediately adjoining, and it was followed later by four other cases in the same house. The next was in a house a few yards further away, also followed later by a secondary case in the same house.

The group of cases thus related with case E occurred in an area in which during 1899 much opportunity for specific soil-pollution existed. The cases were in an overcrowded poor neighbourhood, where the drains and pavement were most defective and where privy middens were abundant and foul. There was no reason as regards these cases to suspect the milk supply, food supply, or public water service. Wells were closed early in the epidemic, cases were removed to hospital, privies were cleansed, drains were tinkered up, yet the incidence of the fever in this locality continued unabated until the middle of October, when it suddenly ceased.

The rainfall was low in July and August, while in September it was unusually heavy.

Water Supply in Relation to the Outbreak.

Out of a total of 2,562 houses in the infected area 1,712 were supplied from the Urban District Council's mains, 808 obtained their water from wells, and the remaining 42 had both sources available. Of 2,520 houses in the infected area 68 per cent. had tap water only, and 32 per cent. had pump water only. Of 69 invaded houses in the same area 35 had tap water only, 31 had pump water only, and 3 had both. Neglecting the last 3, there were 66 invaded houses, of which 53 per cent. had tap water only, and 47 per cent. had pump water only.

The following table represents the proportionate incidence more exactly: —

TABLE VII.

—	Supplied with tap water only.	Supplied with pump water only.	Both tap and pump water accessible.
Out of 100 houses in the infected area	67·	31·	2·
Out of 100 invaded houses in the infected area.	51·	45·	4·

These figures are consistent with the pump water in the infected area having been concerned in some degree in dissemination of the fever. The chemical analyses of well water (referred to under Water Supply) support the suspicion. On the other hand, chemical condemnation does not imply more than the possibility of specific infection, and the houses supplied with well water only are, taken as a whole, the houses with the most sanitary defects, and with the greatest liability to be in relation with polluted soil. Again, in some cases where a single pump supplied a whole court, closure of the pump did not prevent subsequent invasion of houses in the court.

As to opportunities of pollution of particular wells, or of particular series of wells, I made some inquiry in the Abbey Street district. Here 37 separate well waters chemically analysed, had all of them recently been pronounced to show signs of organic pollution. There was some difficulty in inspecting the interior of wells owing to the fact that all the wells were covered in, and few of the inhabitants would permit their wells to be opened for examination. However, a few wells were opened, and a section was prepared for me by Mr. Pickering, the Surveyor, showing their water levels as compared with the level of sewers in the Abbey Street area. As far as can be judged from the few wells represented in the section, it would seem that the water levels in the different wells of this area correspond one with another, and hence it is not impossible that specific contamination of the ground water hereabouts might influence the water of several wells. Questions arose, indeed, whether considerable local pollution of ground water might not have occurred, not long antecedent to the Abbey Street outbreak, by way of leakage from neighbouring sewers.

At the date of Mr. Pickering's observations, the level of the water in the wells examined stood higher than that of the main Abbey Street sewer. At my visit the subsoil water was unusually high, the weather very wet, the river full, some of the surrounding country flooded, and pumping at the sewage works arrested owing to influx of river water into the pumping well. No record of the

movements of subsoil water could be obtained, nor could any information be given by the inhabitants owing to their wells not being open to observation; nevertheless I found reason for suspecting that during dry weather the level of the well-water is probably now and again lower than that of the main Abbey Street sewer. All the wells examined were dry-steined with brick. As to the freedom with which the ground water was likely to flow, I had not a sufficiently extensive knowledge of the character of the subsoil to judge; but given leaky sewers and leaky privy pits near to dry-steined shallow wells sunk in a sufficiently pervious soil, and contamination of well-water must needs follow. If this contamination contained the specific matter of enteric fever, an epidemic prevalence of the disease would be especially likely in dry weather, when lowering of well levels would tend to produce an inflow of water polluted by leakage from the neighbouring sewers. It is not unlikely that such specific contamination did occur during 1899 in the Abbey Street locality, and did mischief in the early part of the epidemic, before most of the wells were closed. In any case, the wells of Nuneaton will remain a danger until they are finally supplanted by the public water service.

As to *sewers* in relation to the fever. The majority of the houses invaded were not in direct connection with the sewers. In most cases the invaded houses were served by privy middens, which were emptied by cart. Slop water was, however, often emptied outside the doors, and conveyed to the sewers by drains which were not unfrequently leaky and untrapped. Thus it was possible for gaseous emanations from the sewers to discharge themselves close to the doors and windows of dwelling-houses. Whether the smells complained of in some of the courts were due to this cause I am not prepared to say.

As to *direct personal infection*, 26 cases from 20 houses were secondary in point of time to previous cases in the same house, but how many of these were due to direct personal infection, and how many to exposure to the same source of infection as the first case or cases, there is not sufficient evidence forthcoming to determine. There were (Table IV., page 156), during 1899, 88 houses invaded; in 46 of them the patients were removed to hospital, and in 42 they were treated at their own homes. Secondary cases, 14 or more days after the first invasion, occurred in two houses of the 46 from which patients were removed, and in 5 of the 42 houses in which patients were treated.

Indirect personal infection.—One case was traced with a good measure of probability to infection derived from the washing of clothes soiled by a fever patient.

Conclusion.—A number of causes may be thought of as having had a share in the distribution of enteric fever in this urban district in 1899. Amongst them the following appear to have been prominent:—

Local pollution of soil,

Personal infection,

Polluted well-water.

MEASURES ADOPTED TO CHECK THE EPIDEMIC.

Invaded premises were in all cases visited by one of the Urban Council's officers, and a handbill left setting forth the precautions which should be taken to avoid the spread of infection. Bed-pans were provided where necessary, and disinfectants supplied free of cost. Directions were left that water and milk should be boiled before use. Two nurses were provided who visited patients at their own homes. Thirty-one cases were removed to the isolation hospital, sixteen to the cottage hospital, and one to the workhouse. When defects of drainage and filth nuisances were detected, measures were taken for their improvement. As a result water closets were in many cases substituted for privy middens.

On the other hand, bedding was not disinfected in the steam disinfector possessed by the local authority. Some of the persons living in the worst and most unsuitable houses were nursed at home, and in certain of these houses a number of attacks from direct personal infection occurred.

SANITARY ADMINISTRATION.

The Medical Officer of Health is Mr. E. Peacock, who has held the office for many years. He is also Medical Officer of Health to the Urban District Council of Bulkington, and is engaged in private practice. His salary in regard of the district now in question is £100 per annum, half of which is repaid from county funds.

The Inspector of Nuisances, Mr. G. W. Andrews, has been recently appointed. His yearly salary is £100, half being repaid from the county funds. Formerly this work was performed in addition to his own by Mr. J. S. Pickering, the Surveyor to the Council. The Inspector of Nuisances is also Inspector of Markets, of Dairies, Cowsheds, and Milk Shops, and Inspector under the Food and Drugs Acts.

The District Council have made bye-laws with respect to new streets and buildings, common lodging houses, slaughter houses, and cleansing of footways and pavements, all of which were allowed by the Board in 1893. Regulations under the Dairies, Cowsheds, and Milk Shops Order were made in 1899.

The Infectious Disease (Notification) Act, 1889, was adopted in 1889, the Public Health Acts Amendment Act, 1890, in 1891, and the Infectious Disease (Prevention) Act, 1890, in 1894.

The Council possesses an isolation hospital capable of accommodating 16 patients. It is a temporary building of the Humphreys' corrugated iron pattern. Its accommodation is in emergency increased by six beds contained in a "small-pox hospital," constructed apparently of wood and canvas. This latter erection does not appear capable of withstanding any great stress of weather. The whole hospital arrangement cannot be regarded as other than makeshift.

There is at the sewage works a Washington Lyon steam disinfector, the property of the Council.

Since it would appear, from the rapid increase of the population in the Urban District of Nuneaton and Chilvers Coton during the last nine years, that Nuneaton is likely in the future to become a town of much greater importance than at present, the Council would do well to consider the question of reconstructing their sewers, and of adopting measures under the Housing of the Working Classes Act for the improvement of the Abbey Street locality.

The large privy middens which still exist, inclusive of many only recently constructed, are a source of nuisance of a grave kind, and cannot fail to be injurious to health. Fixed receptacles for excrement, if allowed to be retained, should be reduced to the smallest practicable dimensions, and so constructed as to keep out all unnecessary moisture, and to facilitate the mingling of ashes with the excrement. All privies at present causing nuisance should be promptly dealt with. The contents of excrement and refuse receptacles should be removed from them at intervals of not longer than a fortnight.

Recommendations in the above sense were made to the Sanitary Authority of Nuneaton by Mr. Spear, one of the Board's Medical Inspectors, so long ago as 1886.

The powers of the Council under the Public Health Act, 1875, for the removal of patients to hospital, where their own houses do not afford suitable accommodation, should be more freely made use of. Steps should be taken to secure permanent and adequate hospital accommodation.

Repeated chemical analysis of samples from the shallow wells of the district should be instituted, and where water is found unfit for drinking purposes, the well should be closed and the public water service substituted. Slop-water gullies and private drains should be systematically inspected and action taken to remedy their numerous defects.

Steps should also be taken to secure satisfactory paving of yards with impervious material.

I have to thank Mr. Peacock, the Medical Officer of Health, Mr. Pickersgill, the Surveyor, and the Clerk to the District Council, for information supplied to me. Mr. Andrews, Inspector of Nuisances, was of service during my inquiry, not only on account of his knowledge of the district, but also in procuring for me data which I required. To the Medical Officer of Health of Coventry I am indebted for the appended figures as to rainfall.

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RAINFALL, COVENTRY, 1899.

July.	August.	September.	October.
Inches.	Inches.	Inches.	Inches.
1st ... ·36	6th ... ·01	1st ... ·01	1st ... ·37
2nd ... ·15	7th ... ·05	2nd ... ·05	2nd ... ·01
3rd ... ·05	8th ... ·02	5th ... ·20	3rd ... ·06
10th ... ·04	9th ... ·005	6th ... 1·49	4th ... ·10
11th ... ·08	15th ... ·12	7th .. 1·12	12th ... ·22
18th ... ·01	16th ... ·38	9th ... ·02	13th ... ·01
21st ... ·01	18th ... ·03	11th ... ·02	22nd ... ·02
22nd ... ·35	27th ... ·02	13th ... ·03	25th ... ·07
26th ... ·14	28th ... ·04	15th ... ·07	26th ... ·12
—	29th ... ·18	16th ... ·25	27th ... ·70
—	30th ... ·19	18th ... ·03	29th ... ·47
—	31st ... ·24	19th ... ·19	30th ... ·01
—	—	21st ... ·08	—
—	—	23rd ... ·12	—
—	—	24th ... ·04	—
—	—	25th ... ·04	—
—	—	26th ... ·02	—
—	—	27th ... ·23	—
—	—	28th ... ·04	—
—	—	29th ... ·65	—
—	—	30th ... ·03	—
Total ... 1·11	Total ... 1·285	Total ... 4·73	Total ... 2·16

No. 13.

REPORT upon an OUTBREAK of TYPHUS FEVER in the URBAN DISTRICT of HEXHAM; by DR. E. PETRONELL MANBY.

Hexham is an ancient and picturesque town on the northern confines of the Urban District of Hexham, which has an area of 5,136 acres, and a population estimated at 7,000. The town is situated on a gravel knoll abutting on the river Tyne. Its chief industries are tanning, and market and nursery gardening.

The town has a good public water supply, derived from springs in the millstone grit, at Allendale Common, about 10 miles to the south. The system of sewerage and house drainage appears to be not unsatisfactory. Sewage at the higher or western outfall, representing about a quarter of the total, is treated by septic tank and bacterial filters; the remainder is treated by chemical precipitation. In both cases the effluent passes directly into the Tyne. Refuse is collected by the District Council's scavengers, and deposited in an old mill-race on Tyne Green, which it is desired to fill up, and which will form part of a new pleasure ground.

The only part of the town where poor class tenement property prevails is in a small low-lying area adjacent to Gilesgate. In this locality many of the houses are old and crowded together, and there appears to be some overcrowding of persons in dwellings. The inhabitants of the area in question seem to constitute the poorest and most improvident of the population of Hexham.

In a word, typhus fever, if introduced into Hexham, had in the neighbourhood of Gilesgate special opportunity for spreading. It was here that the outbreak of typhus now to be described developed, but although in the course of this outbreak the fever was transferred to five other quarters of Hexham, in not one of them was there extension of the disease.

Shortly, the history of the outbreak is as follows:—

In June, 1900, Mrs. Y., aged 46, the wife of a travelling hawker and horsedealer, died at Ryal Common, a place some miles from Hexham, in the Castle Ward Rural District.

The Ys. were encamped at Ryal, and Mrs. Y. had been ill there for some days before she was seen by a medical man. On June 19th, she was taken in a covered gipsy-cart to see a doctor at Stamfordham, some miles from Ryal. She was then unconscious, and it appears that diarrhœa was the principal symptom noticed. Next day the doctor called at the gipsy encampment, and found Mrs. Y. partially conscious but obviously sinking fast, and the following day (June 21st) she died. After consultation with the registrar a certificate of death from "diarrhœa" was given, there being no reason to suspect death as having resulted from fever.

For some weeks prior to May 31st, 1900, Mrs. Y. had been attending her daughter, Mrs. W., through a severe illness of an

indefinite character. This was at Tonepit, North Tyne, and I am informed that the medical man who attended Mrs. W. now thinks it highly probable that her illness was typhus fever, although at the time no actual diagnosis was made. Elevation of temperature and bronchitis were the most prominent symptoms of this woman's illness.

On May 31st Mrs. W. had been admitted to the Hexham Workhouse for debility and bronchitis remaining after her illness, and was discharged cured on June 18th. Mrs. Y. returned to Ryal Common the day that her daughter went into the Hexham Workhouse. No history of illness antecedent to that of Mrs. W. could be traced in either the W. or the Y. family. According to a statement of one of their relatives the Ws. came to Tonepit from "somewhere in Scotland," but no definite place could be fixed.

On June 23rd, after Mrs. Y.'s death and burial, her family moved to Hexham, and stayed from that date till July 23rd, more or less continuously, with some relations named D., who occupied a tenement in a block of dwellings known as the "Mystery." This place is situated at the junction of Foundry Lane and Gilesgate in the low-lying area already referred to.

On July 14th Margaret Y., aged 13, who had been ill some days at the Ds.' house, was admitted to the Hexham Workhouse, and on July 23rd the rest of the Y. family, six in all, followed her there, partly on account of destitution, and partly because Thomas Y., aged 17, and Francis Y., aged 21, were ill.

The last two people were, on July 25th, notified by the Workhouse Medical Officer to Dr. Jackson, Medical Officer of Health of Hexham Urban District, as having typhoid fever. On August 5th Esther Y., aged 10, was similarly notified.

On August 10 two female inmates of the workhouse of many years standing—Mary A., aged 66, and Tamar W., aged 50—were notified as having typhus fever. Both these cases terminated fatally, as might be expected looking to their age. There is little doubt they were infected by Margaret Y., who, as has been said, went into the workhouse on July 14th, and, not presenting then or later any signs of infectious illness, was treated in the same ward with these two women.

On September 5th the Medical Officer of Health was notified that George D., aged 48, was suffering from typhus fever in the "Mystery." This man was the head of the family with whom the Ys. had stayed on their arrival in Hexham. On visiting the "Mystery," Dr. Jackson found the man had been dead some hours. Prompt steps were then taken as to burial of the body, disinfection of premises, discovery and inspection of persons who had been in relation with the sick, &c.

On September 8th two adults (each with an infant) and four children, all members of a family named N., were found to have typhus at a house in Foundry Lane, just opposite the "Mystery." They were at once removed to the District Council's Hospital for Infectious Diseases, which happened to be empty at the time.

No. 18
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APP.

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There had been constant communication between the Ns. and the Ds. and the Ys.

On September 12th two more N. children from this house were removed to hospital with typhus fever.

On September 13th, 14th, and 15th single cases were reported respectively at Quatrebras Cottages, Portland Terrace, and Back Street, all places remote from the "Mystery" and the Gilesgate area (*see* map). These three cases were children attending the infants' department of the Board School, and one of them used to sit next one of the Ns. in school, so that the source of their infection was clear.

The last of these three new cases was removed to hospital, but the medical men in charge of the other two would not sanction their removal, and the Medical Officer of Health having ascertained that a certain amount of isolation was in each case available at the child's home, did not press the matter for the moment, the hospital being then practically full.

On September 16th James N., aged 10, a cousin of the N. children above mentioned, developed typhus and was removed to hospital.

There had been no further cases when I first visited Hexham on September 17th, 1900.

The next case, Mary D., aged 14, occurred on September 25th, in the "Mystery."

On September 27th John S., aged 30, was removed to hospital with fully developed typhus fever. He lived in Tannery Terrace, about ¼-mile from the "Mystery," but had sold garden produce there on several occasions, and had probably contracted the infection from one of the Ds.

On September 28th three more Ds. were removed from the "Mystery" with typhus fever, and the same day a nurse at the fever hospital sickened with the disease.

On October 8th James G., aged 50, of Pearson's Terrace, was removed to hospital with typhus. He was almost moribund on admission and died next day. He had collected rents in the "Mystery" during the prevalence of the fever there.

The last case from the town occurred on October 10th in the person of Annie C., aged 10, who lived next door but one to the Ds. in the "Mystery."

The man, John S., appears to have suffered from a relapse of typhus fever on October 23rd, but he recovered and was discharged from hospital on December 14th.

Including Mrs. W. and Mrs. Y., a total of 32 cases of typhus fever, or probable typhus fever, came under notice in Hexham—and of these, five were fatal, all being persons over 40 years of age.

APP. A, No. 13.

Typhus Fever in the Urban District of Hexham; by Dr. Manby.

Appended to this report is a table of cases (Table I.), a "chronological tree" (Table II.) showing the descent of infection from case to case and from family to family, and a table (Table III.) showing number of attacks and deaths at the various age periods.

In this outbreak of typhus fever the several links in the chain of infection may be considered complete except for the period between the Y. family going to the workhouse on July 23rd, and the onset of the fatal illness of George D., Senr., of the "Mystery," on or about September 1st. It appeared, however, on detailed enquiry that, besides the cases of illness reported to the Medical Officer of Health, three members of the D. family had been seriously ill at home between the date of arrival of the Ys. at the "Mystery" and the illness of George D., Senr. The first of these three, Thomas D., aged 22, attended Mrs. Ys'. funeral on June 23rd, and fell ill two or three weeks later. His sister, Elsbeth D., aged 20, sickened some days after him, and later on still the third case, George D., Junr., aged 17, developed. All these people were seen by a medical man, but as their cases were regarded as "brain fever" the Medical Officer of Health was not informed of their illness at the time. Thomas D. was first seen medically on July 16th having then been ill some time, Elsbeth D. was first seen on July 23rd, and George D., Junr., on August 20th. All three persons had high temperature and marked cerebral symptoms; but the medical man in attendance assures me no rash was was present at any time while they were under his care.

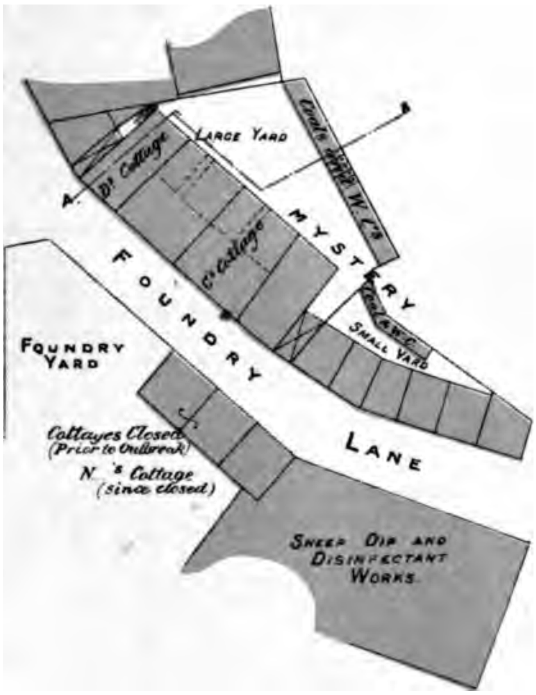
I was told by neighbours that in the early stage of these D.s' illness they were frequently seen wandering to and from the Ns'. house in a dazed condition as if under the influence of drink. It is possible that alcohol may have been indulged in to excess at one or another stage of their illness, but there can, I think, be little doubt that Thomas, Elsbeth, and George D. suffered from typhus fever.

There was an interval of 28 days between the dates at which Elsbeth D. and George D., Junr., were first seen medically. As, however, Elsbeth continued ill for some time after July 23rd, and George was taken ill at least a week or ten days before August 20th, the chain of personal infection is not disconnected. On the other hand, some of the assumed incubation periods in Table II. may appear somewhat short; those, however, who have seen much of typhus fever have, I think, come to realise that what may be called the normal or "text book" period of 12 days is now and again considerably exceeded, and, perhaps, as often reduced.

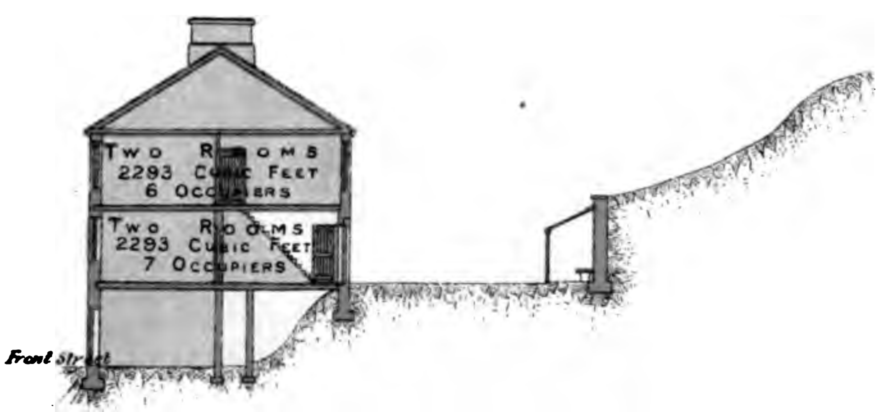
The course of the disease was, I understood, in most cases typical. The series of cases shows, as has been so often pointed out before, that typhus in children is a very mild disease, and in adults, particularly those above 40 years of age, a very fatal one.

The occurrence of a well-marked relapse reported in the case of the man John S. is unusual and noteworthy. The nurse who was attacked recovered. Infection from typhus is frequently contracted by nurses casually attending typhus patients, and I think the Council may be congratulated that no more of its staff contracted the disease.

PLAN AND SECTION OF THE MYSTERY.



Scale 60 feet to 1 inch.



SECTION A. B.

Scale 24 feet to 1 inch.

E. Weller & Grahams, Ltd Litho. London.

Brief Description of the "Mystery" and the Cottage occupied by the N. Family.

The accompanying rough plans and sections indicate the arrangements of these dwellings.

The "Mystery" consists of 10 houses, side by side, facing Foundry Lane, a street averaging 20 feet in width. Four of the houses are three-storey and the remainder two-storey. The total number of rooms in the "Mystery" is 47, and the population at the time of the typhus outbreak was 129—the actual number of tenements being 23.

The tenements on the upper two floors of the four large houses are approached from a back yard, access to which is obtained from Foundry Lane by a "tunnel entrance" at one end, and by a similar entrance and some stone steps at the other. The back yard, unevenly laid with cobble stones except for a paved strip adjoining the houses, is roughly triangular in shape and only 2,628 square feet in extent. To the west it is shut in by a brick wall 10 feet high with rising ground behind, and to the south by other houses. In consequence of this arrangement free circulation of air is rendered almost impossible. This condition was made worse by the tenants keeping a large number of hens in some lean-to buildings intended for coal houses, on each side of the water-closets in the yard.

The three ground floor tenements in the larger block of buildings face Foundry Lane, they have no through ventilation, and the tenants have to use water-closets in the "Mystery" yard.

The Ds. occupied a four-roomed tenement at the southern end of the large block, and the average cubic space available per head, when it was occupied by 13 persons, was no more than 353 cubic feet. At the time of my visit this tenement had just been cleaned and limewashed, but nevertheless it appeared a squalid dwelling. The floors, stairs, ceilings, and walls were in a most dilapidated condition, and the people seemed squalid also.

The Ns.' cottage was one of three facing Foundry Lane, immediately opposite one entrance to the "Mystery" yard. The cottage contained but two rooms and had no back premises, the closet being provided in a little yard at the end of the row. The only possible through ventilation of the cottage was by means of a small back window 2 feet by 3 feet on each floor. The total available cubic space in this cottage was 1,000 feet less than at the Ds. for the same number of inhabitants.

The cottage when typhus fever occurred there, is said to have been in a most insanitary condition, both structurally and by reason of the overcrowding. At the time of my visit it had been closed, and it will not be inhabited again.

It is not surprising that, when typhus infection had been introduced into such suitable breeding grounds as I have described, practically all the susceptible inhabitants of these houses sooner or later contracted the disease.

I was informed that Mrs. D. and one or two others who resisted the infection had suffered from typhus fever some years ago, and they may therefore be presumed to have become immune.

App. A, No. 18.

Typhus Fever in the Urban District of Hexham; by Dr. Manby.

ACTION of the URBAN DISTRICT COUNCIL of HEXHAM with regard to the OUTBREAK.

The Council possess a fever hospital, without which the outbreak could not have been so quickly controlled, however able and energetic the Medical Officer of Health. The hospital is a temporary structure of corrugated iron with accommodation for 12 patients. The fact that it was near the workhouse hospital was, on this occasion, an advantage; but, on this account, the hospital would not be suitable for the treatment of smallpox, should that disease arise in Hexham.

Dr. Jackson, the Medical Officer of Health, by whose prompt use of the existing hospital the typhus outbreak was stayed, secured also, on September 14th, the closure of all the schools in Hexham. It is estimated that the number of children in Hexham attending schools of all denominations was about 1,000. Dr. Jackson at the same time arranged that two or three concerts and other public gatherings pending should not be held.

A small sub-committee of the District Council met every morning in the early days of the outbreak, and the Council did all in their power to second the efforts of Dr. Jackson.

I had an interview with the Council on September 18th, for the purpose of discussing action with regard to the outbreak.

In order to obtain additional isolation accommodation as speedily as possible, the Council had applied to the Guardians for the temporary use of their workhouse hospital, failing which, tents were to be procured. A workshop and a disused chapel, shown me as possible overflow hospitals, did not, in either case, appear at all suitable for the purpose.

The Guardians, with the sanction of the Local Government Board, however, acceded to the request of the District Council, and accommodation for some sixteen additional patients thus became available.

The Guardians stipulated that their hospital should be cut off from the workhouse grounds for the time being, and be administered by the Sanitary Authority. The separation was effected by a fence of corrugated iron 10 feet high, and an entrance from the grounds of the neighbouring fever hospital was provided. Convalescents were transferred to the workhouse hospital as fresh cases of typhus were admitted to the fever hospital.

The premises in the town where cases of typhus fever occurred were thoroughly disinfected and cleansed, and much worthless bedding was destroyed. The District Council has not provided a steam disinfector, so that efficient sterilizing of clothing, &c., was not possible. At my suggestion the schools were disinfected before re-opening on October 29th. "Contacts" were watched, and, as far as is known, only in one case (that of Mary D.) was any concealment of sickness attempted.

The N.s' cottage was permanently closed as being unfit for human habitation, and the owner of the "Mystery" was to be pressed to do everything to render dwellings there as wholesome

as possible. It was also suggested that the ground floor tenements in the "Mystery," which had no through ventilation, might, on that account, be closed as unfit for human habitation.

On a subsequent visit to Hexham (January 11th, 1901), I found repairs to the "Mystery" in progress. Floors and window frames were being renewed, and ceilings and walls partially replastered. The stripping of paper from the walls did not, however, appear to have been carried out in a thorough manner, and the Sanitary Inspector's attention was directed to this point.

I was also informed that the landlord was submitting plans to the District Council showing how through ventilation could be provided for the three ground floor tenements in the larger block of buildings. A reference to the section of this block will show that any measure of this kind is unlikely to be satisfactory, from a sanitary point of view.

The "Mystery" was only erected some 24 years ago, and it appears that the Medical Officer of Health expressed at that time his disapproval of the plans submitted. If this be so, a heavy responsibility must rest on those who allowed the building to proceed. Dr. Jackson tells me his chief objections were that the building was so large and high. He wanted it to be two storeys only, and much more broken up, so that better circulation of air around, and less crowding of families inside, might be secured. There were no building byelaws in force at Hexham at that time.

I understand the cottage occupied by the Ns., and the two others adjoining it, had been reported to the Council as unfit for habitation in July, 1899. The owner made an appeal to the Council, and finally, closure of the two end houses only was insisted on. As a matter of fact, however, all three houses were closed for a time, and then N. obtained the permission of the landlord to occupy one of the houses at a rental of 1*s*. 6*d*. per week until he could find a better place.

At the time of my first visit to Hexham the District Council appeared to be anxious to deal without delay with any property in the town which was known to be insanitary. A report by Dr. Jackson, dated October 18th, 1900, and a verbal communication from him later, would seem to show that some steps in this direction have now been taken. It is to be hoped that this outbreak of typhus fever may prove a "blessing in disguise," and that the District Council may not put aside the lesson taught by the outbreak now that the immediate danger has passed.

In conclusion, I have to thank Dr. Jackson, the Medical Officer of Health, and Mr. Surtees, the Surveyor and Inspector of Nuisances, for much valuable help and information—the latter gentleman was also good enough to prepare the plan and section attached to this report.

Dr. Hembrough, the County Medical Officer of Health, was so good as to obtain for me, at considerable personal inconvenience, information which threw more light on the nature and history of the illnesses of Mrs. W. and Mrs. Y than I was able to get in Hexham.

TABLE I.

No.	Name.	Address.	Age.	Date of Notification to Medical Officer of Health.	Date of Removal to Hospital.	Termination of Illness.	Remarks.
1	Mrs. Elizabeth W.	Tonepit House ..	26	—	Workhouse, May 31	Recovered	Ill for many weeks prior to May 31, at Tonepit. Only suffering from bronchitis when admitted to Hexham Workhouse.
2	Mrs. Annie Y. ..	Ryal Common ..	46	—	—	Died ..	Taken in moribund state to see a doctor two days before death. Attended Mrs. W. (her daughter) for five or six weeks prior to May 31.
3	Margaret Y. ..	The Mystery ..	13	—	Workhouse, July 14 (? in second week of illness).	Recovered	Admitted to sick ward at Hexham Workhouse with signs of illness of an indefinite character.
4	Thomas D... ..	" ..	22	—	—		Ill at home with "brain fever" for several weeks. First seen medically July 16, then ill some days. Attended Mrs. Y.'s funeral at Ryal on June 28.
5	Elsbeth D... ..	..	20	—	—	"	Also attended Mrs. Y.'s funeral. Taken ill with similar symptoms a few days after Thomas. First seen medically July 23.
6	Thomas Y... ..	" ..	17	July 26 (as enteric)	Workhouse, July 28	"	After Mrs. Y.'s death and burial, the rest of her family came to live with the Ds.', at Hexham, arriving June 28. Margaret Y. went to the workhouse on July 14, and the rest of the Y. family followed on July 28.
7	Francis Y.	" ..	21	July 26 (as enteric)	" "	"	
8	Esther Y.	" ..	10	August 5 (as enteric).	" "	"	
9	Mary A.	The Workhouse ..	66	August 8 ..	Inmates of Workhouse.	Died	These old women were probably infected by Margaret Y., who never showed any definite signs of typhus fever, and occupied the same ward with them.
10	Tamar W.	" ..	60	" 10 ..		"	
11	George D., junr. ..	The Mystery ..	17	—	—	Recovered	Attended at home for "brain fever." First seen medically on August 20, but had then been ill some days.
12	George D., senr. ..	" ..	48	September 5 ..	—	Died ..	Ill at home for about one week before death, with symptoms similar to those of Thomas, Elsbeth, and George D., junior.

13	Ralph N.	Foundry Lane ..	14	September 8 ..	Fever Hospital, September 8.	Recovered	
14	Polly N.	„ ..	5	„ 8 ..	„ „	„	
15	Rachel N.	„ ..	9	„ 8 ..	„ „	„	The Ns.' cottage was opposite The Mystery, and there was constant communication between the D., Y., and N. families.
16	Mrs. N. and infant	„ ..	40	„ 8 ..	„ „	„	
17	Lizzie N. and infant	„ ..	20	„ 8 ..	„ „	„	The infant of Lizzie N. died in hospital, but there was never any evidence that either of these infants had typhus fever.
18	Thomas N.	„ ..	7	„ 8 ..	„ „	„	
19	John N.	„ ..	8	„ 12 ..	Fever Hospital, September 12.	„	
20	Charles N.	„ ..	18	12 ..	„ „	„	
21	James McN. ..	Quatrebas Cottages	5½	„ 13 ..	Not removed	„	The medical man in attendance would not sanction the removal of these cases to hospital.
22	Elizabeth H. ..	Portland Terrace ..	9½	„ 14 ..	Not removed	„	
23	Mary D.	Back Street ..	6	„ 15 ..	Fever Hospital, September 15.	„	The three children, McN., H., and D. . . . ., were probably infected from some of the Ns. at school.
24	James N.	Bridge End ..	10	„ 16 ..	16 ..	„	Cousin of the other Ns., and probably infected at school.
25	John S.	Tannery Terrace ..	30	„ 27 ..	„ 27 ..	„	? a relapse case. Admitted to hospital at end of second week of illness. Temperature fell by crisis next day. Convalescence slow. Commenced a typical attack of typhus on October 23, and was discharged cured on December 14. Was a gardener, and sold garden produce in The Mystery.
26	Mary D.	The Mystery ..	14	„ 26 ..	„ 26 ..	„	
27	Margaret D. ..	„ ..	14	„ 28 ..	„ 28 ..	„	
28	Frank D.	„ ..	10	„ 28 ..	„ 28 ..	„	
29	George D.	„ ..	12	„ 28 ..	„ 28 ..	„	
30	Edith B.	Fever Hospital ..	26	„ 28 ..	„ 28 ..	„	A nurse at the Fever Hospital.
31	James G.	Pearson's Terrace	50	October 8 ..	October 8	Died ..	Collected rents in The Mystery. Moribund on admission to hospital, and died next day.
32	Annie C.	The Mystery ..	10	„ 10 ..	„ 10	Recovered	Lived next door but one to the Ds.

App. A, No. 13.

Typhus Fever in the Urban District of Hexham; by Dr. Manby.

TABLE II.

Mrs. W.
(Ill many weeks prior to May 31 at Tonepit.)

Mrs. Y.
(Died June 21, at Byal.)

Thomas D.
(First seen medically July 16. Had been then ill some time.)

Margaret Y.
(Admitted to Hexham W.H. July 14. Had been then ill some time.)

Mary A.
(Inmate of W.H. Died Aug. 8.)

Tamar W.
(Inmate of W.H. Died Aug. 10.)

Elsbeth D.
(Became ill about July 20.)

Thomas Y.
(Admitted to W.H. ill, July 23.)

Francis Y.
(Admitted to W.H. ill, July 23.)

Esther Y.
(Admitted to W.H. ill, July 23.)

George D., aged 17.
(First seen medically Aug. 20, but ill some days prior to that.)

George D., aged 48.
(Died Sept. 5, after a week's illness.)

Ralph N. Sept. 8. | Polly N. Sept. 8. | Rachael N. Sept. 8. | Mrs. N. and infant. Sept. 8. | Lizzie N. and infant. Sept. 8. | Thomas N. Sept. 8. | John N. Sept. 12. | Charles N. Sept. 12.

Jas. McN. Sept. 13. | Elizabeth H. Sept. 14. | Mary D. Sept. 15. | James N. Sept. 16.

Mary D. Sept. 25. | John S. Sept. 27. | Margaret D. Sept. 28. | Frank D. Sept. 28. | George D., aged 12. Sept. 28.

James G. Oct. 8. Died Oct. 9. | Annie C. Oct. 10.

Where the dates only are given they refer to the date on which the cases were notified to the Medical Officer of Health.

TABLE III.

Age Period.	No. of Attacks.	No. of Deaths.
0—10	7	—
10—20	12	—
20—30	6	—
30—40	1	—
40+	6	5

APP. A, No. 14.

Compilation of Returns of Notified Infectious Diseases, and registered Deaths therefrom.

No. 14.

TABLE showing Quarter by Quarter, during the Year 1900, for each of REGISTERED DEATHS from the under-mentioned DISEASES, URBAN DISTRICTS in question.

[The Cases are a Summary of the Weekly Returns of Notifiable Diseases received Quarterly Returns of

In Registration Divisions.	Urban Districts.	Population (1891).	SMALL-POX.									
			1st Quarter.		2nd Quarter.		3rd Quarter.		4th Quarter.		Total for 1900.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
I.	London .. .. .. (*Administrative County.*)	4,232,118	29	1	40	2	16	—	4	1	89	4
II. South-Eastern.	Croydon	102,695	—	—	1	—	—	—	—	—	1	—
	Dover	33,300	—	—	—	—	—	—	—	—	—	—
	Eastbourne	34,969	—	—	1	—	—	—	—	—	1	—
	Brighton	115,873	—	—	—	—	—	—	—	—	—	—
	Portsmouth	159,278	—	—	—	—	—	—	—	—	—	—
	Bournemouth	37,781	—	—	—	—	—	—	—	—	—	—
	Southampton	65,325	3	—	11	—	—	—	8	1	22	1
	Reading	60,054	—	—	—	—	—	—	—	—	—	—
III. South Midland.	Willesden	61,265	—	—	—	—	—	—	—	—	—	—
	Hornsey	44,205	—	—	—	—	—	—	—	—	—	—
	Tottenham	71,343	1	—	—	—	—	—	—	—	1	—
	Oxford	45,742	—	—	—	—	—	—	—	—	—	—
	Northampton	61,012	—	—	—	—	—	—	—	—	—	—
	Cambridge	36,983	—	—	—	—	—	—	—	—	—	—
IV. Eastern.	Leyton	63,056	—	—	—	—	—	—	—	—	—	—
	Walthamstow	46,346	—	—	—	—	—	—	—	—	—	—
	West Ham	204,903	9	—	1	—	—	—	—	—	10	—
	Colchester..	34,559	—	—	—	—	—	—	—	—	—	—
	Norwich	100,970	—	—	—	—	—	—	—	—	—	—
V. South-Western.	Exeter	37,404	—	—	—	—	—	—	—	—	—	—
	Plymouth	84,248	—	—	—	—	—	—	—	—	—	—
	Devonport	54,803	—	—	—	—	—	—	—	—	—	—
	Bath..	51,844	—	—	—	—	—	—	—	—	—	—
VI. West Midland.	Bristol	258,296	—	—	—	—	—	—	—	—	—	—
	Gloucester..	39,444	—	—	—	—	—	—	—	—	—	—
	Cheltenham	47,514	—	—	—	—	—	—	—	—	—	—
	Hanley	54,946	—	—	—	—	—	—	—	—	—	—
	Longton	34,327	—	—	—	—	—	—	—	—	—	—
	Burton-on-Trent ..	46,047	—	—	—	—	—	—	—	—	—	—
	Wolverhampton ..	82,662	—	—	4	1	—	—	—	—	4	1
	Walsall	71,789	—	—	—	—	—	—	—	—	—	—
	West Bromwich.. ..	59,474	—	—	—	—	—	—	—	—	—	—
	Worcester	42,908	—	—	—	—	—	—	—	—	—	—
	Smethwick	36,170	—	—	—	—	—	—	—	—	—	—
	Birmingham	478,113	2	—	—	—	—	—	—	—	2	—
	Aston Manor	68,639	—	—	—	—	—	—	—	—	—	—
	Coventry	52,724	—	—	—	—	—	—	—	—	—	—
VII. North Midland.	Leicester	174,624	—	—	—	—	—	—	—	—	—	—
	Grimsby	51,934	4	—	—	—	—	—	—	—	4	—
	Nottingham	213,877	—	—	—	—	—	—	—	—	—	—
	Derby	94,146	—	—	—	—	—	—	1	—	1	—

APP. A, No.

Compilatioı Returns of Notified Inf tious Diseas and register Deaths ther from.

No. 14.

of 94 URBAN DISTRICTS, the NUMBER of NOTIFIED CASES and together with an ANNUAL SUMMARY of these data for each of the

by the Board from Medical Officers of Health. The Deaths are extracted from the the Registrar-General.]

In Registration Divisions.	Urban Districts.	Population (1891).	SMALL-POX—*continued.* 1st Quarter. Cases.	1st Quarter. Deaths.	2nd Quarter. Cases.	2nd Quarter. Deaths.	3rd Quarter. Cases.	3rd Quarter. Deaths.	4th Quarter. Cases.	4th Quarter. Deaths.	Total for 1900. Cases.	Total for 1900. Deaths.
VIII. North-Western.	Stockport	70,263	—	—	—	—	—	—	—	—	—	—
	Macclesfield	36,000	1	—	—	—	—	—	—	—	1	—
	Chester	37,105	—	—	—	—	—	—	—	—	—	—
	Birkenhead	99,857	—	—	—	—	—	—	—	—	—	—
	Wallasey	33,229	—	—	—	—	—	—	—	—	—	—
	Bootle	49,217	—	—	3	1	—	—	—	—	3	1
	Liverpool	629,443	28	2	81	13	31	7	9	—	149	22
	St. Helens (Lancs.) ..	71,288	—	—	—	—	—	—	—	—	—	—
	Southport	41,406	—	—	—	—	1	—	—	—	1	—
	Wigan	55,013	—	—	—	—	—	—	—	—	—	—
	Warrington	52,743	—	—	—	—	—	—	—	—	—	—
	Bolton	115,002	—	—	1	—	—	—	—	—	1	—
	Bury (Lancs.)	57,212	—	—	—	—	3	—	—	—	3	—
	Salford	198,139	—	—	7	1	—	—	—	—	7	1
	Manchester	505,368	—	—	3	—	—	—	—	—	3	—
	Ashton-under-Lyne ..	40,463	—	—	5	—	—	—	—	—	5	—
	Oldham	131,463	—	—	6	2	2	1	—	—	8	3
	Rochdale	71,401	—	—	1	—	—	—	1	—	2	—
	Accrington	38,603	—	—	—	—	—	—	—	—	—	—
	Burnley	87,016	1	—	—	—	—	—	—	—	1	—
	Blackburn	120,064	—	—	1	—	22	2	—	—	23	2
	Darwen	34,192	—	—	—	—	—	—	—	—	—	—
	Preston	107,573	—	—	—	—	—	—	—	—	—	—
	Barrow-in-Furness ..	51,712	—	—	—	—	—	—	2	—	2	—
IX. Yorkshire.	Keighley	30,810	—	—	—	—	—	—	—	—	—	—
	Huddersfield	95,420	—	—	—	—	—	—	—	—	—	—
	Halifax	89,832	—	—	2	—	—	—	—	—	2	—
	Bradford	216,361	—	—	—	—	—	—	3	—	3	—
	Leeds	367,505	1	1	—	—	—	—	—	—	1	1
	Wakefield	33,146	—	—	1	—	—	—	—	—	1	—
	Barnsley	35,427	—	—	—	—	—	—	—	—	—	—
	Sheffield	324,243	—	—	—	—	—	—	—	—	—	—
	Rotherham	42,061	—	—	—	—	—	—	—	—	—	—
	York	67,004	—	—	—	—	—	—	—	—	—	—
	Hull	200,044	95	21	11	—	2	—	—	—	108	21
	Scarborough	33,776	—	—	—	—	—	—	—	—	—	—
	Middlesbrough	75,532	—	—	—	—	—	—	—	—	—	—
X. Northern.	Darlington	38,060	—	—	—	—	—	—	—	—	—	—
	Stockton-on-Tees ..	49,705	—	—	—	—	—	—	—	—	—	—
	West Hartlepool ..	42,710	—	—	—	—	—	—	10	—	10	—
	Sunderland	131,015	—	—	—	—	—	—	1	—	1	—
	Jarrow	33,675	—	—	—	—	—	—	—	—	—	—
	South Shields	78,391	—	—	—	—	—	—	2	—	2	—
	Gateshead	85,692	—	—	—	—	—	—	—	—	—	—
	Newcastle-on-Tyne ..	186,300	—	—	—	—	—	—	—	—	—	—
	Tynemouth	46,588	—	—	1	—	—	—	1	1	2	1
	Carlisle	39,176	—	—	—	—	—	—	—	—	—	—
XI. Welsh.	Newport (Mon.)	54,707	—	—	1	—	—	—	1	—	2	—
	Cardiff	128,915	3	1	1	1	—	—	—	—	4	2
	Rhondda	88,351	—	—	—	—	—	—	1	—	1	—
	Merthyr Tydfil	58,080	—	—	—	—	—	—	4	1	4	1
	Swansea	90,349	—	—	—	—	1	—	—	—	1	—
	Totals, 94 Districts ..	13,244,357	177	26	183	21	78	10	48	4	486	61

P. A, No. 14.

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In Registration Divisions.	Urban Districts.	Population (1891).	Scarlet Fever. 1st Quarter. Cases.	Deaths.	2nd Quarter. Cases.	Deaths.	3rd Quarter. Cases.	Deaths.	4th Quarter. Cases.	Deaths.	Total for 1900. Cases.	Deaths.
I.	London .. .. .. (*Administrative County.*)	4,232,118	2,865	84	3,283	97	3,219	70	4,463	110	13,830	361
II. South-Eastern.	Croydon	102,695	117	2	99	1	98	—	120	2	434	5
	Dover	33,300	86	5	79	1	35	1	69	—	269	7
	Eastbourne	34,969	19	—	9	—	9	—	14	—	51	—
	Brighton	115,873	242	6	174	5	71	—	82	1	569	12
	Portsmouth	159,278	70	5	76	2	90	2	113	2	349	11
	Bournemouth	37,781	43	1	33	2	12	2	25	—	113	5
	Southampton	65,325	57	1	33	—	71	—	46	1	207	2
	Reading	60,054	30	—	36	—	55	1	117	1	238	2
III. South Midland.	Willesden	61,265	82	3	66	6	99	1	84	3	331	13
	Hornsey	44,205	57	1	35	—	39	—	53	—	184	1
	Tottenham	71,343	73	—	83	—	107	3	149	3	412	6
	Oxford	45,742	8	—	8	—	6	—	17	—	39	—
	Northampton	61,012	26	3	10	—	19	—	44	—	99	3
	Cambridge	36,983	13	—	24	—	39	—	73	2	149	2
IV. Eastern.	Leyton	63,056	55	4	84	—	70	2	67	1	276	7
	Walthamstow ..	46,346	101	2	114	1	55	—	76	2	346	5
	West Ham	204,903	167	5	145	1	104	3	237	6	713	15
	Colchester	34,559	33	2	12	—	14	—	9	—	68	2
	Norwich	100,970	18	—	15	—	15	—	40	—	88	—
V. South-Western.	Exeter	37,404	29	—	14	—	9	—	12	2	64	2
	Plymouth	84,248	15	1	27	—	8	—	15	—	65	1
	Devonport	54,803	14	1	10	1	13	—	14	—	51	2
	Bath	51,844	25	—	17	—	5	—	39	3	86	3
VI. West Midland.	Bristol	258,296	287	8	272	6	525	11	887	14	1,971	39
	Gloucester	39,444	13	—	29	—	33	1	57	—	132	1
	Cheltenham	47,514	57	—	20	—	7	—	18	—	102	—
	Hanley	54,946	115	5	72	2	55	1	39	1	231	9
	Longton	34,327	73	4	65	3	53	6	126	3	317	16
	Burton-on-Trent ..	46,047	41	—	25	—	23	—	23	—	112	—
	Wolverhampton ..	82,662	41	2	44	2	60	2	101	2	246	8
	Walsall	71,789	37	1	44	1	70	—	152	2	303	4
	West Bromwich ..	59,474	63	3	49	2	24	—	48	—	184	5
	Worcester	42,908	50	1	21	2	15	—	9	—	95	3
	Smethwick	36,170	42	—	34	1	19	1	27	1	122	3
	Birmingham	478,113	304	17	490	27	604	24	667	28	2,085	96
	Aston Manor	68,639	30	1	81	3	145	2	151	4	407	10
	Coventry	52,724	94	3	144	5	217	4	185	6	640	18
VII. North Midland.	Leicester	174,624	227	15	198	4	191	5	228	5	844	29
	Grimsby	51,934	31	—	16	—	26	—	27	—	100	—
	Nottingham	213,877	413	13	386	27	263	4	325	10	1,387	54
	Derby	94,146	145	5	120	6	155	4	179	7	599	22

APP. A, No.

Compilation of Returns of Notified Infectious Diseases, and registered Deaths therefrom.

In Registration Divisions.	Urban Districts.	Population (1891).	SCARLET FEVER—*continued.* 1st Quarter. Cases.	1st Quarter. Deaths.	2nd Quarter. Cases.	2nd Quarter. Deaths.	3rd Quarter. Cases.	3rd Quarter. Deaths.	4th Quarter. Cases.	4th Quarter. Deaths.	Total for 1900. Cases.	Total for 1900. Deaths.
VIII. North-Western.	Stockport	70,263	32	—	38	1	77	1	105	3	252	5
	Macclesfield	36,000	28	1	6	—	6	—	9	—	49	1
	Chester	37,105	25	—	17	—	14	—	15	1	71	1
	Birkenhead	99,857	32	—	39	1	43	1	87	1	201	3
	Wallasey	33,229	34	—	37	1	21	1	28	1	120	3
	Bootle	49,217	86	3	47	5	45	3	92	6	270	17
	Liverpool	629,443	451	38	419	21	400	16	704	35	1,974	110
	St. Helens (Lancs.) ..	71,288	74	3	124	9	134	5	244	9	576	26
	Southport	41,406	46	1	75	3	59	—	53	—	233	4
	Wigan	55,013	47	2	114	4	157	8	162	7	480	21
	Warrington	52,743	41	2	22	1	24	1	28	2	115	6
	Bolton	115,002	243	5	152	4	117	3	132	6	644	18
	Bury (Lancs.)	57,212	156	1	107	3	77	2	94	1	434	7
	Salford	198,139	191	19	321	24	406	21	398	35	1,319	99
	Manchester	505,368	600	28	523	24	650	23	815	30	2,588	105
	Ashton-under-Lyne ..	40,463	40	—	37	1	28	—	9	—	114	1
	Oldham	131,463	336	17	277	19	203	12	242	7	1,058	55
	Rochdale	71,401	38	1	19	1	19	1	36	—	112	3
	Accrington	38,603	68	3	61	—	54	1	35	2	218	6
	Burnley	87,016	434	24	196	8	187	7	204	17	1,021	56
	Blackburn	120,064	274	15	344	29	424	19	428	20	1,470	83
	Darwen	34,192	65	4	40	1	39	1	127	5	271	11
	Preston	107,573	179	13	119	8	81	8	112	5	491	34
	Barrow-in-Furness ..	51,712	186	12	116	2	106	2	99	4	507	20
IX. Yorkshire.	Keighley	30,810	112	12	60	4	57	5	77	8	306	29
	Huddersfield	95,420	67	2	96	6	68	5	63	4	294	17
	Halifax	89,832	94	10	62	4	80	2	83	1	328	17
	Bradford	216,361	419	33	311	22	292	5	323	13	1,345	73
	Leeds	367,505	336	5	333	19	391	11	681	17	1,741	52
	Wakefield	33,146	61	5	57	5	72	5	126	5	316	20
	Barnsley	35,427	87	5	83	2	82	3	44	1	296	11
	Sheffield	324,243	510	19	409	17	391	13	480	14	1,790	63
	Rotherham	42,061	72	3	189	3	165	3	295	13	721	22
	York	67,004	40	1	66	—	97	1	114	2	317	4
	Hull	200,044	192	6	404	9	260	11	337	13	1,193	39
	Scarborough	33,776	22	1	28	—	23	—	72	1	145	2
	Middlesbrough ..	75,532	94	7	85	5	45	1	62	—	286	13
X. Northern.	Darlington	38,060	71	4	24	3	18	—	19	—	132	7
	Stockton-on-Tees ..	49,705	41	1	44	1	31	2	25	1	141	5
	West Hartlepool ..	42,710	10	2	24	—	24	—	82	2	140	4
	Sunderland	131,015	113	5	133	4	200	13	302	17	748	39
	Jarrow	33,675	64	1	45	1	86	2	86	—	281	4
	South Shields	78,391	130	5	108	4	95	3	174	8	507	20
	Gateshead	85,692	37	2	61	4	32	1	51	1	181	8
	Newcastle-on-Tyne ..	186,300	137	5	137	3	143	3	182	5	599	16
	Tynemouth	46,588	39	4	36	2	67	1	94	4	236	11
	Carlisle...	39,176	4	—	11	—	16	-	67	2	98	2
XI. Welsh.	Newport (Mon.) ..	54,707	22	—	22	1	82	1	131	2	257	4
	Cardiff	128,915	78	4	90	2	80	1	135	4	383	11
	Rhondda	88,351	175	2	282	6	604	13	771	13	1,832	34
	Merthyr Tydfil ..	58,080	14	—	16	—	32	—	130	3	192	3
	Swansea	90,349	55	—	64	—	65	4	128	3	312	7
	Totals, 94 Districts	13,244,357	13,110	540	13,129	505	13,785	395	18,619	576	58,643	2,016

APP. A, No. 14.

Compilation of Returns of Notified Infectious Diseases, and registered Deaths therefrom.

In Registration Divisions.	Urban Districts.	Population (1891).	DIPHTHERIA. 1st Quarter. Cases.	1st Quarter. Deaths.	2nd Quarter. Cases.	2nd Quarter. Deaths.	3rd Quarter. Cases.	3rd Quarter. Deaths.	4th Quarter. Cases.	4th Quarter. Deaths.	Total for 1900. Cases.	Total for 1900. Deaths.
I.	London .. .. .. (*Administrative County.*)	4,232,118	3,028	533	2,621	320	2,821	299	3,330	406	11,800	1,558
II. South-Eastern.	Croydon	102,695	19	5	36	5	36	4	95	10	186	24
	Dover	33,300	2	1	9	2	13	6	20	5	44	14
	Eastbourne	34,969	9	2	6	1	6	—	24	—	45	3
	Brighton	115,873	177	15	122	14	145	15	206	25	650	69
	Portsmouth	159,278	140	28	82	19	143	19	202	37	567	103
	Bournemouth.. ..	37,781	17	1	12	3	12	2	12	2	53	8
	Southampton	65,325	27	7	27	1	41	8	34	6	129	22
	Reading..	60,054	8	4	4	1	8	1	7	—	27	6
III. South Midland.	Willesden	61,265	62	4	55	8	52	5	58	11	227	28
	Hornsey..	44,205	34	3	23	3	29	5	21	2	107	13
	Tottenham	71,343	42	8	66	4	48	3	37	5	193	20
	Oxford	45,742	33	—	26	1	20	—	52	1	131	2
	Northampton.. ..	61,012	1	4	—	1	1	1	4	1	6	7
	Cambridge	36,983	9	—	3	—	1	—	62	6	75	6
IV. Eastern.	Leyton	63,056	60	10	50	6	50	7	61	5	221	28
	Walthamstow ..	46,346	161	29	128	21	81	8	149	20	519	78
	West Ham	204,903	306	40	191	23	285	35	518	59	1,300	157
	Colchester	34,559	11	3	7	1	28	1	44	8	90	13
	Norwich	100,970	24	4	12	3	14	4	12	1	62	12
V. South-Western.	Exeter	37,404	5	4	2	—	5	2	8	3	20	9
	Plymouth	84,248	32	3	8	2	8	3	8	3	56	11
	Devonport	54,803	3	2	4	2	12	4	35	17	54	25
	Bath	51,844	10	1	13	4	3	—	18	3	44	8
VI. West Midland.	Bristol	258,296	114	23	110	20	112	23	161	34	497	100
	Gloucester	39,444	10	4	9	1	3	3	14	4	36	12
	Cheltenham	47,514	15	—	31	1	8	—	20	2	74	3
	Hanley	54,946	94	22	67	21	99	22	69	12	329	77
	Longton . ..	34,327	35	4	27	5	15	1	40	2	117	12
	Burton-on-Trent ..	46,047	52	12	117	22	132	17	107	14	408	65
	Wolverhampton ..	82,662	24	3	13	3	34	3	23	—	94	9
	Walsall	71,789	11	5	18	9	13	7	12	3	54	24
	West Bromwich ..	59,474	5	1	4	—	2	—	10	1	21	2
	Worcester	42,908	17	3	11	1	32	—	29	8	89	12
	Smethwick	36,170	29	4	9	1	21	1	15	4	74	10
	Birmingham	478,113	136	24	126	25	113	15	132	11	507	75
	Aston Manor	68,639	31	9	17	1	14	4	19	—	81	14
	Coventry	52,724	5	5	6	3	6	2	24	11	41	21
VII. North Midland.	Leicester	174,624	232	68	231	64	491	100	498	98	1,452	330
	Grimsby	51,934	75	17	75	18	92	12	106	10	318	57
	Nottingham	213,877	42	11	18	4	26	8	27	5	113	28
	Derby	94,146	8	—	8	—	22	1	14	6	52	7

In Registration Divisions.	Urban Districts.	Population (1891).	DIPHTHERIA—*continued.* 1st Quarter. Cases.	1st Quarter. Deaths.	2nd Quarter. Cases.	2nd Quarter. Deaths.	3rd Quarter. Cases.	3rd Quarter. Deaths.	4th Quarter. Cases.	4th Quarter. Deaths.	Total for 1900. Cases.	Total for 1900. Deaths.
VIII. North-Western.	Stockport	70,263	3	1	5	3	5	2	7	3	20	9
	Macclesfield	36,000	3	2	2	—	5	1	6	2	16	5
	Chester	37,105	11	2	2	—	6	2	26	1	45	5
	Birkenhead	99,857	12	1	12	3	8	2	13	5	45	11
	Wallasey	33,229	9	1	5	1	5	—	7	—	26	2
	Bootle	49,217	3	2	2	—	7	2	10	4	22	8
	Liverpool	629,443	169	48	145	34	148	28	221	52	683	162
	St. Helens (Lancs.)	71,288	17	5	12	1	13	5	20	8	62	19
	Southport	41,406	3	—	3	—	3	—	9	2	18	2
	Wigan	55,013	5	1	4	2	2	1	8	—	19	4
	Warrington	52,743	14	6	1	3	—	—	5	2	20	11
	Bolton	115,002	18	6	5	—	8	3	24	11	55	20
	Bury (Lancs.) ..	57,212	5	2	—	—	3	1	5	4	13	7
	Salford	198,139	73	17	41	12	99	32	78	29	291	90
	Manchester	505,368	77	34	49	22	105	17	87	28	318	101
	Ashton-under-Lyne	40,463	3	1	—	—	3	1	1	1	7	3
	Oldham	131,463	40	10	18	5	16	2	15	3	89	20
	Rochdale	71,401	4	2	8	1	4	—	12	—	28	3
	Accrington	38,603	2	—	2	—	11	3	6	3	21	6
	Burnley	87,016	15	3	15	4	14	3	24	12	68	22
	Blackburn	120,064	89	30	64	20	49	12	91	27	293	89
	Darwen	34,192	—	1	3	2	33	6	146	24	182	33
	Preston	107,573	39	18	26	11	20	9	23	7	108	45
	Barrow-in-Furness	51,712	26	9	11	5	3	1	6	1	46	16
IX. Yorkshire.	Keighley	30,810	9	4	36	7	38	6	126	33	209	50
	Huddersfield ..	95,420	5	1	4	1	2	—	3	—	14	2
	Halifax	89,832	15	4	16	6	4	1	4	2	39	13
	Bradford	216,361	22	6	31	7	13	3	40	17	106	33
	Leeds	367,505	328	73	284	57	289	54	312	69	1,213	253
	Wakefield	33,146	9	5	10	—	40	6	30	3	89	14
	Barnsley	35,427	5	2	18	7	14	5	6	5	43	19
	Sheffield	324,243	734	166	408	97	457	81	773	117	2,372	461
	Rotherham	42,061	3	3	9	1	15	7	7	2	34	13
	York	67,004	4	1	3	1	5	—	5	1	17	3
	Hull	200,044	19	5	28	8	20	1	26	5	93	19
	Scarborough ..	33,776	7	1	4	—	13	1	5	2	29	4
	Middlesbrough ..	75,532	10	2	4	—	5	1	6	—	25	3
X. Northern.	Darlington	38,060	2	3	3	1	1	—	4	—	10	4
	Stockton-on-Tees ..	49,705	4	2	14	5	4	2	15	8	37	17
	West Hartlepool ..	42,710	3	2	5	4	2	—	2	2	12	8
	Sunderland	131,015	9	6	10	6	5	3	9	7	33	22
	Jarrow	33,675	2	—	2	1	1	1	2	—	7	2
	South Shields ..	78,391	6	3	3	2	3	2	8	5	20	12
	Gateshead	85,692	2	2	2	1	2	—	12	2	18	5
	Newcastle-on-Tyne	186,300	16	7	15	4	26	4	30	17	87	32
	Tynemouth	46,588	2	3	5	1	6	3	4	2	17	9
	Carlisle	39,176	7	1	5	1	3	1	15	2	30	5
XI. Welsh.	Newport (Mon.) ..	54,707	20	3	20	5	22	1	54	1	116	10
	Cardiff	128,915	171	21	152	25	187	21	198	14	708	81
	Rhondda	88,351	279	38	207	19	361	29	257	30	1,104	116
	Merthyr Tydfil ..	58,080	86	21	38	10	16	1	32	5	172	37
	Swansea	90,349	100	14	152	16	123	19	122	12	497	61
	Totals, 94 Districts	13,244,357	7,674	1,527	6,327	1,066	7,344	1,037	9,294	1,453	30,65[illegible]	5,083

APP. A, No. 14.

Compilation of Returns of Notified Infectious Diseases, and registered Deaths therefrom.

In Registration Divisions.	Urban Districts.	Population (1891).	"Fever." 1st Quarter. Notifications. Typhus.	Enteric.	Continued.	Total.	Deaths.	2nd Quarter. Notifications. Typhus.	Enteric.	Continued.	Total.	Deaths.
I.	London .. .. .. (*Administrative County.*)	4,232,118	2	1,027	15	1,044	204	2	655	16	673	124
II. South-Eastern.	Croydon	102,695	—	12	1	13	1	—	7	1	8	—
	Dover	33,300	—	3	—	3	1	—	8	—	8	2
	Eastbourne	34,969	—	3	—	3	3	—	2	—	2	—
	Brighton	115,873	—	11	—	11	2	—	13	—	13	2
	Portsmouth	159,278	—	33	1	34	2	—	66	7	73	6
	Bournemouth	37,781	—	2	—	2	—	—	2	—	2	1
	Southampton	65,325	—	15	—	15	3	—	20	1	21	3
	Reading	60,054	—	5	—	5	—	—	5	3	8	—
III. South Midland.	Willesden	61,265	—	17	—	17	6	—	12	—	12	4
	Hornsey	44,205	—	4	—	4	—	—	1	—	1	1
	Tottenham	71,343	—	20	—	20	2	—	21	1	22	4
	Oxford	45,742	—	2	—	2	2	—	1	—	1	1
	Northampton	61,012	—	21	—	21	4	—	20	—	20	7
	Cambridge	36,983	—	5	—	5	—	—	1	—	1	—
IV. Eastern.	Leyton	63,056	—	28	—	28	3	—	27	—	27	5
	Walthamstow	46,346	—	20	—	20	2	—	21	—	21	1
	West Ham	204,903	—	105	1	106	17	—	67	—	67	11
	Colchester	34,559	—	2	—	2	—	—	3	—	3	
	Norwich	100,970	—	17	—	17	2	—	20	—	20	3
V. South-Western.	Exeter	37,404	—	28	—	28	3	—	11	—	11	4
	Plymouth	84,248	—	11	—	11	3	—	6	—	6	1
	Devonport	54,803	—	7	—	7	1	—	12	—	12	5
	Bath	51,844	—	8	1	9	2	—	2	—	2	1
VI. West Midland.	Bristol	258,298	—	108	—	108	18	—	45	—	45	11
	Gloucester	39,444	—	1	—	1	1	—	4	—	4	2
	Cheltenham	47,514	—	8	—	8	1	—	5	—	5	1
	Hanley	54,946	—	22	—	22	3	—	14	10	24	5
	Longton	34,327	—	14	—	14	1	—	17	—	17	2
	Burton-on-Trent ..	46,047	—	10	—	10	2	—	3	1	4	1
	Wolverhampton ..	82,662	—	47	2	49	10	—	63	—	63	9
	Walsall	71,789	—	10	—	10	2	—	19	—	19	4
	West Bromwich ..	59,474	—	36	—	36	5	—	16	—	16	4
	Worcester	42,908	—	4	—	4	—	—	3	—	3	1
	Smethwick	36,170	—	11	—	11	6	—	9	—	9	2
	Birmingham	478,113	—	203	1	204	49	—	133	—	133	25
	Aston Manor	68,639	—	36	—	36	8	—	18	1	19	7
	Coventry	52,724	—	5	1	6	1	—	6	—	6	1
VII. North Midland.	Leicester	174,624	—	26	—	26	6	—	27	—	27	10
	Grimsby	51,934	—	12	—	12	1	—	26	4	30	3
	Nottingham	213,877	—	79	—	79	11	—	72	—	72	8
	Derby	94,146	—	39	—	39	7	—	19	—	19	1

"FEVER"—*continued.*

3rd Quarter. Notifications.					4th Quarter. Notifications.					Totals for 1900. Notifications.					Urban Districts.
Typhus.	Enteric.	Continued.	Total.	Deaths.	Typhus.	Enteric.	Continued.	Total.	Deaths.	Typhus.	Enteric.	Continued.	Total.	Deaths.	
2	963	22	987	162	1	1,670	20	1,691	275	7	4,315	73	4,395	765	London. (*Administrative County.*)
—	15	1	16	1	—	22	1	23	7	—	56	4	60	9	Croydon.
—	8	—	8	1	—	4	—	4	1	—	23	—	23	5	Dover.
—	4	—	4	1	—	4	—	4	—	—	13	—	13	4	Eastbourne.
—	20	—	20	3	—	34	—	34	4	—	78	—	78	11	Brighton.
—	729	38	767	52	—	262	5	267	32	—	1,090	51	1,141	92	Portsmouth.
—	1	—	1	—	—	2	—	2	1	—	7	—	7	2	Bournemouth.
—	49	3	52	5	—	31	—	31	4	—	115	4	119	15	Southampton.
—	8	—	8	2	—	10	—	10	—	—	28	3	31	2	Reading.
—	16	—	16	4	—	31	—	31	1	—	76	—	76	15	Willesden.
—	12	—	12	—	—	14	—	14	5	—	31	—	31	6	Hornsey.
—	29	—	29	2	—	38	—	38	2	—	108	1	109	10	Tottenham.
—	14	—	14	1	—	7	—	7	—	—	24	—	24	4	Oxford.
—	16	—	16	2	3	11	—	14	2	3	68	—	71	15	Northampton.
—	14	—	14	1	—	14	—	14	—	—	34	—	34	1	Cambridge.
—	32	1	33	3	—	27	2	29	5	—	114	3	117	16	Leyton.
—	22	—	22	1	—	23	1	24	3	—	86	1	87	7	Walthamstow.
—	79	—	79	13	—	103	1	104	16	—	354	2	356	57	West Ham.
—	9	—	9	3	—	9	—	9	—	—	23	—	23	3	Colchester.
—	73	1	74	3	—	53	—	53	6	—	163	1	164	14	Norwich.
—	40	2	43	5	—	11	—	11	3	—	90	2	92	15	Exeter.
—	12	1	13	3	—	96	1	97	14	—	125	2	127	21	Plymouth.
—	7	—	7	2	—	6	—	6	5	—	32	—	32	13	Devonport.
—	—	—	—	—	—	6	—	6	2	—	16	1	17	5	Bath.
—	68	1	69	5	—	72	1	73	8	—	293	2	295	42	Bristol.
—	2	—	2	3	—	1	—	1	1	—	8	—	8	7	Gloucester.
—	4	—	4	—	—	12	—	12	4	—	29	—	29	6	Cheltenham.
—	17	—	17	1	—	16	—	16	5	—	69	10	79	14	Hanley.
—	11	—	11	6	—	19	—	19	5	—	61	—	61	14	Longton.
—	6	—	6	—	—	5	1	6	1	—	24	2	26	4	Burton-on-Trent.
—	40	—	40	4	—	61	—	61	17	—	211	2	213	40	Wolverhampton.
—	37	—	37	6	—	12	—	12	2	—	78	—	78	14	Walsall.
—	24	—	24	5	—	37	1	38	9	—	113	1	114	23	West Bromwich.
—	—	1	1	—	—	4	—	4	—	—	11	1	12	1	Worcester.
—	15	—	15	—	—	20	—	20	3	—	55	—	55	11	Smethwick.
—	151	—	151	31	—	385	—	385	74	—	872	1	873	179	Birmingham.
—	29	—	29	4	—	60	1	61	7	—	143	2	145	26	Aston Manor.
—	7	2	9	2	—	29	3	32	4	—	47	6	53	8	Coventry.
—	31	—	31	4	—	40	—	40	6	—	124	—	124	26	Leicester.
—	92	1	93	8	—	36	3	39	2	—	166	8	174	14	Grimsby.
—	136	—	136	18	—	220	—	220	42	—	507	—	507	79	Nottingham.
—	24	—	24	1	—	39	3	42	11	—	121	3	124	20	Derby.

PP. A, No. 14.

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In Registration Divisions.	Urban Districts.	Population (1891).	"FEVER"—*continued.*									
			1st Quarter.					2nd Quarter.				
			Notifications.					Notifications.				
			Typhus.	Enteric.	Continued.	Total.	Deaths.	Typhus.	Enteric.	Continued.	Total.	Deaths.
VIII. North-Western.	Stockport	70,263	—	10	—	10	3	—	12	—	12	3
	Macclesfield	36,000	—	13	—	13	2	—	7	—	7	2
	Chester	37,105	—	28	—	28	3	—	16	—	16	—
	Birkenhead	99,857	—	19	—	19	2	—	20	8	28	4
	Wallasey	33,229	—	26	—	26	3	—	31	—	31	2
	Bootle	49,217	—	14	—	14	—	—	13	—	13	4
	Liverpool	629,443	6	142	6	154	26	10	157	11	178	29
	St. Helens (Lancs.) ..	71,288	—	15	—	15	2	—	22	—	22	4
	Southport	41,406	—	3	—	3	—	—	9	—	9	3
	Wigan	55,013	—	29	—	29	5	—	16	—	16	2
	Warrington	52,743	—	14	—	14	3	—	11	—	11	4
	Bolton	115,002	—	57	—	57	10	—	26	—	26	10
	Bury (Lancs.)	57,212	—	10	3	13	2	—	5	2	7	2
	Salford	198,139	1	49	2	52	11	—	45	2	47	11
	Manchester	505,368	—	100	—	100	19	—	95	—	95	16
	Ashton-under-Lyne ..	40,463	—	10	—	10	1	—	12	—	12	6
	Oldham	131,463	—	20	1	21	6	—	5	—	5	1
	Rochdale	71,401	—	7	—	7	—	—	9	—	9	1
	Accrington	38,603	—	7	—	7	3	—	8	—	8	1
	Burnley	87,016	—	11	—	11	2	—	15	—	15	5
	Blackburn	120,064	—	33	—	33	7	—	25	—	25	5
	Darwen	34,192	—	7	—	7	3	—	4	—	4	—
	Preston	107,573	—	34	2	36	9	—	31	2	33	7
	Barrow-in-Furness ..	51,712	—	6	1	7	4	—	19	1	20	2
IX. Yorkshire.	Keighley	30,810	—	7	—	7	2	—	13	—	13	2
	Huddersfield	95,420	—	9	—	9	3	—	15	—	15	5
	Halifax	89,832	—	12	—	12	4	4	13	—	17	4
	Bradford	216,361	—	66	—	66	19	—	38	1	39	12
	Leeds	367,505	—	59	1	60	17	2	129	2	133	19
	Wakefield	33,146	—	5	—	5	1	—	23	—	23	3
	Barnsley	35,427	—	35	—	35	4	—	9	—	9	1
	Sheffield	324,243	—	75	1	76	17	—	46	—	46	5
	Rotherham	42,061	—	21	—	21	2	—	15	—	15	3
	York	67,004	—	6	—	6	2	—	17	—	17	2
	Hull	200,044	—	22	4	26	7	—	19	2	21	10
	Scarborough	33,776	—	2	—	2	2	—	2	—	2	2
	Middlesbrough	75,532	—	19	—	19	3	—	17	1	18	5
X. Northern.	Darlington	38,060	—	11	—	11	1	—	8	—	8	—
	Stockton-on-Tees ..	49,705	—	6	—	6	3	—	10	4	14	1
	West Hartlepool ..	42,710	—	1	1	2	—	—	5	—	5	—
	Sunderland	131,015	—	28	3	31	6	—	57	11	68	10
	Jarrow	33,675	—	9	—	9	—	—	1	—	1	—
	South Shields	78,391	—	9	1	10	6	—	9	1	10	4
	Gateshead	85,692	—	5	1	6	3	—	5	—	5	1
	Newcastle-on-Tyne ..	186,300	—	18	—	18	6	—	15	1	16	4
	Tynemouth	46,588	—	8	—	8	3	—	3	—	3	—
	Carlisle	39,176	—	1	—	1	1	—	—	—	—	—
XI. Welsh.	Newport (Mon.) ..	54,707	—	15	—	15	1	—	7	—	7	1
	Cardiff	128,915	—	12	1	13	5	—	23	1	24	4
	Rhondda	88,351	—	55	1	56	11	—	30	2	32	4
	Merthyr Tydfil	58,080	—	51	—	51	10	—	80	—	80	9
	Swansea	90,349	1	9	—	10	3	—	14	—	14	5
	Totals, 94 Districts ..	13,244,357	10	3,317	52	3,379	663	18	2,738	97	2,853	523

"FEVER"—*continued.*

3rd Quarter.					4th Quarter.					Totals for 1900.					Urban Districts.
Notifications.					Notifications.					Notifications.					
Typhus.	Enteric.	Continued.	Total.	Deaths.	Typhus.	Enteric.	Continued.	Total.	Deaths.	Typhus.	Enteric.	Continued.	Total.	Deaths.	
—	16	—	16	3	—	37	1	38	9	—	75	1	76	18	Stockport.
—	16	—	16	1	—	25	—	25	5	—	61	—	61	10	Macclesfield.
—	14	—	14	1	—	12	—	12	1	—	70	—	70	5	Chester.
—	38	2	40	4	—	87	4	91	6	—	164	14	178	16	Birkenhead.
—	28	—	28	6	—	75	—	75	6	—	160	—	160	17	Wallasey.
—	26	—	26	4	—	44	—	44	8	—	97	—	97	16	Bootle.
15	219	6	240	33	8	239	13	260	43	39	757	36	832	131	Liverpool.
—	57	—	57	7	—	29	1	30	9	—	123	1	124	22	St. Helens (Lancs.).
—	12	—	12	2	—	15	—	15	3	—	39	—	39	8	Southport.
—	25	—	25	3	—	33	—	33	8	—	103	—	103	18	Wigan.
—	12	—	12	3	—	21	—	21	5	—	58	—	58	15	Warrington.
—	40	—	40	9	—	85	—	85	16	—	208	—	208	45	Bolton.
—	7	4	11	—	—	20	3	23	4	—	42	12	54	8	Bury (Lancs.).
—	95	2	97	24	—	146	2	148	22	1	335	8	344	68	Salford.
1	89	1	91	12	—	141	—	141	28	1	425	1	427	75	Manchester.
—	17	—	17	3	—	19	—	19	4	—	58	—	58	14	Ashton - under - Lyne.
—	20	—	20	4	—	27	—	27	6	—	72	1	73	17	Oldham.
—	6	—	6	1	—	7	—	7	1	—	29	—	29	3	Rochdale.
—	10	—	10	1	—	8	—	8	2	—	33	—	33	7	Accrington.
—	16	—	16	3	—	23	—	23	6	—	65	—	65	16	Burnley.
—	28	—	28	3	—	79	—	79	15	—	165	—	165	30	Blackburn.
—	5	1	6	—	—	17	—	17	1	—	33	1	34	4	Darwen.
—	39	5	44	11	—	57	4	61	19	—	161	13	174	46	Preston.
—	26	1	27	3	—	27	1	28	9	—	78	4	82	18	Barrow - in - Furness.
—	7	-	7	2	—	30	1	31	2	—	57	1	58	8	Keighley.
—	13	—	13	6	—	17	—	17	5	—	54	—	54	19	Huddersfield.
1	17	—	18	5	—	36	1	37	9	5	78	1	84	22	Halifax.
—	95	1	96	14	—	117	—	117	21	—	316	2	318	66	Bradford.
—	143	1	144	28	—	136	3	139	20	2	467	7	476	84	Leeds.
—	35	—	35	7	1	17	—	18	2	1	80	—	81	13	Wakefield.
—	11	—	11	—	—	33	—	33	2	—	88	—	88	7	Barnsley.
—	203	—	203	35	—	203	—	203	45	—	527	1	528	102	Sheffield.
—	16	—	16	—	—	26	—	26	3	—	78	—	78	8	Rotherham.
—	136	—	136	15	—	87	—	87	18	—	246	—	246	37	York.
—	85	5	90	15	—	82	5	87	18	—	208	16	224	50	Hull.
—	10	—	10	1	—	12	2	14	2	—	26	2	28	7	Scarborough.
—	31	—	31	4	—	29	1	30	8	—	96	2	98	20	Middlesbrough.
—	8	—	8	2	—	14	—	14	3	—	41	—	41	6	Darlington.
—	19	—	19	1	—	15	—	15	2	—	50	4	54	7	Stockton-on-Tees.
—	12	—	12	3	—	7	—	7	2	—	25	1	26	5	West Hartlepool.
—	121	10	131	18	1	94	7	102	21	1	300	31	332	55	Sunderland.
—	28	8	36	7	—	18	—	18	3	—	56	8	64	10	Jarrow.
—	26	3	29	6	—	27	—	27	3	—	71	5	76	19	South Shields.
—	13	1	14	1	—	26	—	26	4	—	49	2	51	9	Gateshead.
—	28	—	28	5	2	19	—	21	3	2	80	1	83	18	Newcastle - on - Tyne.
—	2	—	2	—	—	8	—	8	4	—	21	—	21	7	Tynemouth.
—	1	—	1	—	—	4	—	4	1	—	6	—	6	2	Carlisle.
—	11	—	11	3	—	21	—	21	3	—	54	—	54	8	Newport (Mon.).
2	34	3	39	7	—	26	—	26	7	2	95	5	102	23	Cardiff.
—	30	2	32	3	—	61	—	61	7	—	176	5	181	25	Rhondda.
—	99	—	99	13	—	39	1	40	8	—	269	1	270	40	Merthyr Tydfil.
—	29	—	29	4	—	31	—	31	4	1	83	—	84	16	Swansea.
21	4,990	130	5,141	714	16	6,064	94	6,174	1,056	65	17,109	373	17,547	2,955	Totals, 94 Districts.

No. 15.

TABLE showing, Week by Week, during the Year 1900, for each of the SANITARY AREAS within
NOTIFIED CASES of and REGISTERED DEATHS from the following DISEASES, together with

[The Cases are copied from the Weekly Returns of Notifiable Diseases received by the Board from the Metropolita

	Sanitary Areas.	Population (1891).	SMALL-POX. Weekly Statement, 1st Quarter, 1900. Jan. 6. Cases.	Jan. 6. Deaths.	Jan. 13. Cases.	Jan. 13. Deaths.	Jan. 20. Cases.	Jan. 20. Deaths.	Jan. 27. Cases.	Jan. 27. Deaths.	Feb. 3. Cases.	Feb. 3. Deaths.	Feb. 10 Cases.	Feb. 10 Deaths.	Feb. 17. Cases.	Feb. 17. Deaths.
	London .. .. (*Administrative County.*)	4,232,118	1	—	10	—	3	—	5	—	2	—	1	—	—	—
W. District.	Kensington	166,308	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Fulham	91,639	—	—	—	—	—	—	2	—	—	—	1	—	—	—
	Hammersmith	97,239	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Paddington	117,846	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Chelsea..	96,253	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. George, Hanover Sq.* ..	78,599	—	—	—	—	—	—	—	—	1	—	—	—	—	—
	Westminster	55,539	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. James, Westminster ..	24,995	—	—	—	—	—	—	—	—	—	—	—	—	—	—
N. District.	St. Marylebone	142,404	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Hampstead	68,416	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. Pancras	234,379	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Islington	319,143	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. Mary, Stoke Newington	30,936	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Hackney	198,606	—	—	8	—	1	—	1	—	1	—	—	—	—	—
Central District.	St. Giles and St. George, Bloomsbury.	39,782	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. Martin-in-the-Fields ..	14,616	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Strand†	25,217	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Holborn‡	34,043	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Clerkenwell	66,216	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. Luke, Middlesex ..	42,440	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	London, City of§	37,583	—	—	—	—	—	—	—	—	—	—	—	—	—	—
E. District.	Shoreditch	124,009	—	—	—	—	1	—	1	—	—	—	—	—	—	—
	Bethnal Green	129,132	—	—	1	—	1	—	—	—	—	—	—	—	—	—
	Whitechapel‖	74,420	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. George-in-the-East ..	45,795	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Limehouse	57,376	—	—	—	—	—	—	1	—	—	—	—	—	—	—
	Mile End Old Town ..	107,592	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Poplar	166,748	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	St. Saviour, Southwark ..	27,177	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. George, Southwark ..	59,712	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Newington	115,804	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. Olave, Southwark ..	12,723	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Bermondsey	84,682	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Rotherhithe	39,255	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Lambeth	275,203	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Battersea	150,558	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Wandsworth	156,942	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Camberwell	235,344	—	—	1	—	—	—	—	—	—	—	—	—	—	—
	Greenwich	165,413	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Lewisham	92,647	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Woolwich	40,848	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Plumstead	52,436	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Lee	36,103	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Port of London	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—

* *Including St. Peter's,* Westminster (population, 235). † Including Middle Temple (population, 95).
‡ *Including Gray's Inn* (population, 253), Lincoln's Inn (population, 27), Charterhouse (population 126),
Staple Inn (population, 21), and Furnival's Inn (population, 121).

No. 15.

the ADMINISTRATIVE COUNTY of LONDON and for the COUNTY as a WHOLE, the NUMBER of QUARTERLY and ANNUAL SUMMARIES of these Data for each of the AREAS in question.

Asylums Board. The Deaths are extracted from the Weekly Returns compiled by the Registrar-General.]

SMALL-POX—*continued.*														
Weekly Statement, 1st Quarter, 1900—*continued.*												Totals for 1st Quarter, 1900.		Sanitary Areas.
Feb. 24.		Mar. 3.		Mar. 10.		Mar. 17.		Mar. 24.		Mar. 31.				
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
2	—	1	1	1	—	3	—	—	—	—	—	29	1	London. (*Administrative County*)
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Kensington.
—	—	—	—	—	—	—	—	—	—	—	—	3	—	Fulham.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Hammersmith.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Paddington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Chelsea.
—	—	—	—	—	—	—	—	—	—	—	—	1	—	St. George, Hanover Sq.*
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Westminster.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. James, Westminster.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Marylebone.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Hampstead.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Pancras.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Islington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Mary, Stoke Newington
—	—	—	—	—	—	2	—	—	—	—	—	13	—	Hackney.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Giles and St. George, Bloomsbury.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Martin-in-the-Fields.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Strand.†
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Holborn.‡
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Clerkenwell.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Luke, Middlesex.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	London, City of.§
—	—	—	—	—	—	—	—	—	—	—	—	2	—	Shoreditch.
—	—	—	—	—	—	—	—	—	—	—	—	2	—	Bethnal Green.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Whitechapel.‖
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. George-in-the-East.
—	—	—	—	—	—	—	—	—	—	—	—	1	—	Limehouse.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Mile End Old Town.
1	—	—	—	1	—	—	—	—	—	—	—	2	—	Poplar.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Saviour, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. George, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Newington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Olave, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Bermondsey.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Rotherhithe.
—	—	—	—	—	—	1	—	—	—	—	—	1	—	Lambeth.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Battersea.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Wandsworth.
—	—	—	—	—	—	—	—	—	—	—	—	1	—	Camberwell.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Greenwich.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Lewisham.
1	—	1	1	—	—	—	—	—	—	—	—	2	1	Woolwich.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Plumstead.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Lee.
—	—	—	—	—	—	—	—	—	—	—	—	1	—	Port of London.

§ Including Inner Temple (*population, 96*). ‖ Including Tower of London (population, 888).

Sanitary Areas.	Population (1891).	SMALL-POX—*continued.* Weekly Statement, 2nd Quarter, 1900. April 7. Cases.	April 7. Deaths.	April 14. Cases.	April 14. Deaths.	April 21. Cases.	April 21. Deaths.	April 28. Cases.	April 28. Deaths.	May 5. Cases.	May 5. Deaths.	May 12. Cases.	May 12. Deaths.	May 19. Cases.	May 19. Deaths.
London .. .. (*Administrative County.*)	4,232,118	—	—	2	—	1	—	5	1	—	—	1	1	1	—
W. District. Kensington	166,308	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Fulham	91,639	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Hammersmith	97,239	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Paddington	117,846	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Chelsea	96,253	—	—	—	—	—	—	—	—	—	—	—	—	—	—
St. George, Hanover Sq.*	78,599	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Westminster	55,539	—	—	—	—	—	—	—	—	—	—	—	—	—	—
St. James, Westminster ..	24,995	—	—	—	—	—	—	—	—	—	—	—	—	—	—
N. District. St. Marylebone	142,404	—	—	1	—	—	—	2	1	—	—	1	1	—	—
Hampstead	68,416	—	—	—	—	—	—	—	—	—	—	—	—	—	—
St. Pancras	234,379	—	—	1	—	—	—	3	—	—	—	—	—	—	—
Islington	319,143	—	—	—	—	—	—	—	—	—	—	—	—	—	—
St. Mary, Stoke Newington	30,936		—	—	—	—	—	—	—	—	—	—	—	—	—
Hackney	198,606		—	—	—	1	—	—	—	—	—	—		—	—
Central District. St. Giles and St. George, Bloomsbury.	39,782		—	—	—	—	—	—	—	—	—	—		—	—
St. Martin-in-the-Fields ..	14,616		—	—	—	—	—	—	—	—	—	—		—	—
Strand†	25,217		—	—	—	—	—	—	—	—	—	—		—	—
Holborn‡	34,043		—	—	—	—	—	—	—	—	—	—		—	—
Clerkenwell	66,216		—	—	—	—	—	—	—	—	—	—		—	—
St. Luke, Middlesex ..	42,440	—	—	—	—	—	—	—	—	—	—	—		—	—
London, City of§	37,583	—	—	—	—	—	—	—	—	—	—	—	—	—	—
E. District. Shoreditch	124,009	—	—	—	—	—	—	—	—	—	—	—	—	1	—
Bethnal Green	129,132	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Whitechapel‖	74,420	—	—	—	—	—	—	—	—	—	—	—	—	—	—
St. George-in-the-East ..	45,795	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Limehouse	57,376	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Mile End Old Town ..	107,592	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Poplar	166,748	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District. St. Saviour, Southwark ..	27,177	—	—	—	—	—	—	—	—	—	—	—	—	—	—
St. George, Southwark ..	59,712	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Newington	115,804	—	—	—	—	—	—	—	—	—	—	—	—	—	—
St. Olave, Southwark ..	12,723	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Bermondsey	84,682	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Rotherhithe	39,255	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Lambeth	275,203	—	—	—	—	—	—		—	—	—	—	—	—	—
Battersea	150,558	—	—	—	—	—	—		—	—	—	—	—	—	
Wandsworth..	156,942	—	—	—	—	—	—		—	—	—	—	—	—	
Camberwell	235,344	—	—	—	—	—	—		—	—	—	—	—	—	
Greenwich	165,413	—	—	—	—	—	—		—	—	—	—	—	—	
Lewisham	92,647	—	—	—	—	—	—		—	—	—	—	—	—	
Woolwich	40,848	—	—	—	—	—	—	—	—	—	—	—	—	—	
Plumstead	52,436	—	—	—	—	—	—	—	—	—	—	—	—	—	
Lee	36,103	—	—	—	—	—	—	—	—	—	—	—	—	—	
Port of London	—	—	—	—	—	—	—	—	—	—	—	—	—	—	

* Including St. Peter's, Westminster (population, 235). † Including Middle Temple (population, 95).
‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136) Staple Inn (population, 21), and Furnival's Inn (population, 121).

SMALL-POX—*continued.*

Weekly Statement 2nd Quarter, 1900—*continued.*												Totals for 2nd Quarter, 1900.		Sanitary Areas.
May 26.		June 2.		June 9.		June 16.		June 23.		June 30.				
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
4	—	2	—	4	—	9	—	2	—	8	—	39	2	London.
														(*Administrative County.*)
—	—	1	—	1	—	—	—	—	—	4	—	6	—	Kensington.
—	—	—	—	—	—	—	—	—	—	3	—	3	—	Fulham.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Hammersmith.
—	—	—	—	—	—	4	—	1	—	—	—	5	—	Paddington.
1	—	—	—	—	—	—	—	—	—	—	—	1	—	Chelsea.
1	—	—	—	—	—	—	—	—	—	—	—	1	—	St. George, Hanover Sq.*
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Westminster.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. James, Westminster.
1	—	—	—	—	—	—	—	—	—	—	—	5	2	St. Marylebone.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Hampstead.
—	—	—	—	—	—	—	—	—	—	—	—	4	—	St. Pancras.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Islington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Mary, Stoke Newington.
—	—	—	—	—	—	1	—	—	—	—	—	2	—	Hackney.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Giles and St. George, Bloomsbury.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Martin-in-the-Fields.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Strand.†
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Holborn.‡
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Clerkenwell.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Luke, Middlesex.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	London, City of.§
—	—	—	—	—	—	—	—	—	—	—	—	1	—	Shoreditch.
—	—	—	—	—	—	1	—	—	—	—	—	1	—	Bethnal Green.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Whitechapel.‖
1	—	—	—	3	—	3	—	—	—	—	—	7	—	St. George-in-the-East.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Limehouse.
—	—	1	—	—	—	—	—	—	—	—	—	1	—	Mile End Old Town.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Poplar.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Saviour, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. George, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Newington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Olave, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Bermondsey.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Rotherhithe.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Lambeth.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Battersea.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Wandsworth.
—	—	—	—	—	—	—	—	1	—	—	—	1	—	Camberwell.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Greenwich.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Lewisham.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Woolwich.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Plumstead.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Lee.
—	—	—	—	—	—	—	—	—	—	1	—	1	—	Port of London.

§ Including Inner Temple (population, 96). ‖ Including Tower of London (population, 868).

SMALL-POX—*continued.*

Sanitary Areas.	Population (1891).	Weekly Statement, 3rd Quarter, 1900. July 7. Cases.	July 7. Deaths.	July 14. Cases.	July 14. Deaths.	July 21. Cases.	July 21. Deaths.	July 28. Cases.	July 28. Deaths.	Aug. 4. Cases.	Aug. 4. Deaths.	Aug. 11. Cases.	Aug. 11. Deaths.	Aug. 18. Cases.	Aug. 18. Deaths.
London .. .. (*Administrative County.*)	4,232,118	7	—	2	—	2	—	2	—	—	—	—	—	—	—
W. District.															
Kensington	166,308	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Fulham	91,639	2	—	—	—	—	—	—	—	—	—	—	—	—	—
Hammersmith	97,239	2	—	—	—	—	—	—	—	—	—	—	—	—	—
Paddington	117,846	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Chelsea	96,253	—	—	—	—	—	—	—	—	—	—	—	—	—	—
St. George, Hanover Sq. *	78,599	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Westminster	55,539	—	—	—	—	—	—	—	—	—	—	—	—	—	—
St. James, Westminster ..	24,995	—	—	—	—	—	—	—	—	—	—	—	—	—	—
N. District.															
St. Marylebone	142,404	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Hampstead	68,416	—	—	—	—	—	—	—	—	—	—	—	—	—	—
St. Pancras	234,379	—	—	1	—	1	—	1	—	—	—	—	—	—	—
Islington	319,143	—	—	—	—	—	—	—	—	—	—	—	—	—	—
St. Mary, Stoke Newington	30,936	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Hackney	198,606	—	—	—	—	—	—	1	—	—	—	—	—	—	—
Central District.															
St. Giles and St. George, Bloomsbury.	39,782	—	—	—	—	—	—	—	—	—	—	—	—	—	—
St. Martin-in-the-Fields ..	14,616	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Strand †	25,217	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Holborn ‡	34,043	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Clerkenwell	66,216	—	—	—	—	—	—	—	—	—	—	—	—	—	—
St. Luke, Middlesex ..	42,440	—	—	—	—	—	—	—	—	—	—	—	—	—	—
London, City of § ..	37,583	—	—	—	—	—	—	—	—	—	—	—	—	—	—
E. District.															
Shoreditch	124,009	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Bethnal Green	129,132	—	—	—	—	1	—	—	—	—	—	—	—	—	—
Whitechapel ‖	74,420	1	—	—	—	—	—	—	—	—	—	—	—	—	—
St. George-in-the-East ..	45,795	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Limehouse	57,376	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Mile End Old Town ..	107,592	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Poplar	166,748	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District.															
St. Saviour, Southwark ..	27,177	—	—	—	—	—	—	—	—	—	—	—	—	—	—
St. George, Southwark ..	59,712	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Newington ..	115,804	1	—	—	—	—	—	—	—	—	—	—	—	—	—
St. Olave, Southwark ..	12,723	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Bermondsey	84,682	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Rotherhithe	39,255	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Lambeth	275,203	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Battersea	150,558	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Wandsworth..	156,942	—	—	1	—	—	—	—	—	—	—	—	—	—	—
Camberwell	235,344	1	—	—	—	—	—	—	—	—	—	—	—	—	—
Greenwich	165,413	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Lewisham	92,647	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Woolwich	40,848	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Plumstead	52,436	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Lee	36,103	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Port of London	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

* Including St. Peter's, Westminster (population, 235). † Including Middle Temple (population, 95).
‡ Including Gray's Inn (population, 263), Lincoln's Inn (population, 27), Charterhouse (population, 130), Staple Inn (population, 21), and Furnival's Inn (population, 131).

SMALL-POX—*continued.*

Weekly Statement, 3rd Quarter, 1900—*continued.*											Totals for 3rd Quarter, 1900.		Sanitary Areas.
. 25.	Sept. 1.		Sept. 8.		Sept. 15.		Sept. 22.		Sept. 29.				
Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
—	2	—	1	—	—	—	—	—	—	—	16	—	London. (*Administrative County.*)
—	—	—	—	—	—	—	—	—	—	—	—	—	Kensington.
—	—	—	—	—	—	—	—	—	—	—	2	—	Fulham.
—	—	—	—	—	—	—	—	—	—	—	2	—	Hammersmith.
—	—	—	—	—	—	—	—	—	—	—	—	—	Paddington.
—	—	—	—	—	—	—	—	—	—	—	—	—	Chelsea.
—	—	—	—	—	—	—	—	—	—	—	—	—	St. George, Hanover Sq. *
—	—	—	—	—	—	—	—	—	—	—	—	—	Westminster.
—	—	—	—	—	—	—	—	—	—	—	—	—	St. James, Westminster
—	—	—	—	—	—	—	—	—	—	—	—	—	St. Marylebone.
—	—	—	—	—	—	—	—	—	—	—	—	—	Hampstead.
—	—	—	—	—	—	—	—	—	—	—	3	—	St. Pancras.
—	—	—	—	—	—	—	—	—	—	—	—	—	Islington.
—	—	—	—	—	—	—	—	—	—	—	—	—	St. Mary, Stoke Newington.
—	—	—	—	—	—	—	—	—	—	—	1	—	Hackney.
—	—	—	—	—	—	—	—	—	—	—	—	—	St. Giles and St. George Bloomsbury.
—	—	—	—	—	—	—	—	—	—	—	—	—	St. Martin-in-the-Fields.
—	—	—	—	—	—	—	—	—	—	—	—	—	Strand. †
—	—	—	—	—	—	—	—	—	—	—	—	—	Holborn. ‡
—	—	—	—	—	—	—	—	—	—	—	—	—	Clerkenwell.
—	—	—	—	—	—	—	—	—	—	—	—	—	St. Luke, Middlesex.
—	—	—	—	—	—	—	—	—	—	—	—	—	London, City of. §
—	—	—	—	—	—	—	—	—	—	—	—	—	Shoreditch.
—	—	—	—	—	—	—	—	—	—	—	1	—	Bethnal Green.
—	—	—	—	—	—	—	—	—	—	—	1	—	Whitechapel. ‖
—	—	—	—	—	—	—	—	—	—	—	—	—	St. George-in-the-East.
—	—	—	—	—	—	—	—	—	—	—	—	—	Limehouse.
—	—	—	—	—	—	—	—	—	—	—	—	—	Mile End Old Town.
—	—	—	—	—	—	—	—	—	—	—	—	—	Poplar.
—	—	—	—	—	—	—	—	—	—	—	—	—	St. Saviour, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	—	St. George, Southwark.
—	—	—	—	—	—	—	—	—	—	—	1	—	Newington.
—	—	—	—	—	—	—	—	—	—	—	—	—	St. Olave, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	—	Bermondsey.
—	—	—	—	—	—	—	—	—	—	—	—	—	Rotherhithe.
—	—	—	—	—	—	—	—	—	—	—	—	—	Lambeth.
—	—	—	—	—	—	—	—	—	—	—	—	—	Battersea.
—	2	—	1	—	—	—	—	—	—	—	4	—	Wandsworth.
—	—	—	—	—	—	—	—	—	—	—	1	—	Camberwell.
—	—	—	—	—	—	—	—	—	—	—	—	—	Greenwich.
—	—	—	—	—	—	—	—	—	—	—	—	—	Lewisham.
—	—	—	—	—	—	—	—	—	—	—	—	—	Woolwich.
—	—	—	—	—	—	—	—	—	—	—	—	—	Plumstead.
—	—	—	—	—	—	—	—	—	—	—	—	—	Lee.
—	—	—	—	—	—	—	—	—	—	—	—	—	Port of London.

ncluding Inner Temple (population, 96).

‖ Including Tower of London (population, 868).

	Sanitary Areas.	Population (1891).	SMALL-POX—*continued.* Weekly Statement, 4th Quarter, 1900. Oct. 6. Cases.	Oct. 6. Deaths.	Oct. 13. Cases.	Oct. 13. Deaths.	Oct. 20. Cases.	Oct. 20. Deaths.	Oct. 27. Cases.	Oct. 27. Deaths.	Nov. 3. Cases.	Nov. 3. Deaths.	Nov. 10. Cases.	Nov. 10. Deaths.	Nov. 17. Cases.	Nov. 17. Deaths.
	London .. .. (*Administrative County.*)	4,232,118	—	—	—	—	—	—	—	—	1	—	—	—	—	—
W. District.	Kensington	166,308	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Fulham	91,639	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Hammersmith	97,239	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Paddington	117,846	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Chelsea	96,253	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. George, Hanover Sq.*	78,599	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Westminster	55,539	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. James, Westminster ..	24,995	—	—	—	—	—	—	—	—	—	—	—	—	—	—
N. District.	St. Marylebone	142,404	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Hampstead	68,416	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. Pancras	234,379	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Islington	319,143	—	—	—	—	—	—	—	—	1	—	—	—	—	—
	St. Mary, Stoke Newington	30,936	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Hackney	198,606	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Central District.	St. Giles and St. George, Bloomsbury.	39,782	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. Martin-in-the-Fields	14,616	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Strand†	25,217	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Holborn‡	31,043	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Clerkenwell	66,216	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. Luke, Middlesex ..	42,440	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	London, City of §	37,583	—	—	—	—	—	—	—	—	—	—	—	—	—	—
E. District.	Shoreditch	124,009	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Bethnal Green	129,132	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Whitechapel ‖	74,420	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. George-in-the-East ..	45,795	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Limehouse	57,376	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Mile End Old Town ..	107,592	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Poplar	166,748	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	St. Saviour, Southwark ..	27,177	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. George, Southwark ..	59,712	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Newington	115,804	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. Olave, Southwark ..	12,723	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Bermondsey	84,682	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Rotherhithe	39,255	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Lambeth	275,203	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Battersea	150,558	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Wandsworth..	156,942	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Camberwell	235,344	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Greenwich	165,413	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Lewisham	92,647	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Woolwich	40,848	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Plumstead	52,436	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Lee	36,103	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Port of London	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

* Including St. Peter's, Westminster (population, 235). † Including Middle Temple (population, 95).
‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 120), Staple Inn (population, 21), and Furnival's Inn (population, 121)

SMALL-POX—*continued.*

Weekly Statement, 4th Quarter, 1900—*continued.*											Totals for 4th Quarter, 1900.		Grand Totals for Year, 1900.		Sanitary Areas.
Nov. 24.	Dec. 1.		Dec. 8.		Dec. 15.		Dec. 22.		Dec. 29.						
Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
—	—	1	—	—	—	—	—	—	—	—	4	1	88	4	London. (*Administrative County.*)
—	—	—	—	—	—	—	—	—	—	—	—	—	6	—	Kensington.
—	—	—	—	—	—	—	—	—	—	—	1	—	9	—	Fulham.
—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	Hammersmith.
—	—	—	—	—	—	—	—	—	—	—	—	—	5	—	Paddington.
—	—	—	—	—	—	—	—	—	—	—	1	—	2	—	Chelsea.
—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	St. George, Hanover Sq.*
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Westminster.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. James, Westminister.
—	—	—	—	—	—	—	—	—	—	—	—	—	5	2	St. Marylebone.
—	—	—	—	—	—	—	—	—	—	—		—	—	—	Hampstead.
—	—	—	—	—	—	—	—	—	—	—		—	7	—	St. Pancras.
—	—	1	—	—	—	—	—	—	—	—	2	1	2	1	Islington.
—	—	—	—	—	—	—	—	—	—	—		—	—	—	St. Mary, Stoke Newington.
—	—	—	—	—	—	—	—	—	—	—		—	16	—	Hackney.
—	—	—	—	—	—	—	—	—	—	—		—	—	—	St. Giles and St. George, Bloomsbury.
—	—	—	—	—	—	—	—	—	—	—		—	—	—	St. Martin-in-the-Fields.
—	—	—	—	—	—	—	—	—	—	—		—	—	—	Strand.†
—	—	—	—	—	—	—	—	—	—	—		—	—	—	Holborn.‡
—	—	—	—	—	—	—	—	—	—	—		—	—	—	Clerkenwell.
—	—	—	—	—	—	—	—	—	—	—		—	—	—	St. Luke, Middlesex.
—	—	—	—	—	—	—	—	—	—	—		—	—	—	London, City of.§
—	—	—	—	—	—	—	—	—	—	—		—	3	—	Shoreditch.
—	—	—	—	—	—	—	—	—	—	—		—	4	—	Bethnal Green.
—	—	—	—	—	—	—	—	—	—	—		—	1	—	Whitechapel.‖
—	—	—	—	—	—	—	—	—	—	—		—	7	—	St. George-in-the-East.
—	—	—	—	—	—	—	—	—	—	—		—	1	—	Limehouse.
—	—	—	—	—	—	—	—	—	—	—		—	1	—	Mile End Old Town.
—	—	—	—	—	—	—	—	—	—	—		—	2	—	Poplar.
—	—	—	—	—	—	—	—	—	—	—		—	—	—	St. Saviour, Southwark.
—	—	—	—	—	—	—	—	—	—	—		—	—	—	St. George, Southwark.
—	—	—	—	—	—	—	—	—	—	—		—	1	—	Newington.
—	—	—	—	—	—	—	—	—	—	—		—	—	—	St. Olave, Southwark.
—	—	—	—	—	—	—	—	—	—	—		—	—	—	Bermondsey.
—	—	—	—	—	—	—	—	—	—	—		—	—	—	Rotherhithe.
—	—	—	—	—	—	—	—	—	—	—		—	1	—	Lambeth.
—	—	—	—	—	—	—	—	—	—	—		—	—	—	Battersea.
—	—	—	—	—	—	—	—	—	—	—		—	4	—	Wandsworth.
—	—	—	—	—	—	—	—	—	—	—		—	3	—	Camberwell.
—	—	—	—	—	—	—	—	—	—	—		—	—	—	Greenwich.
—	—	—	—	—	—	—	—	—	—	—		—	—	—	Lewisham.
—	—	—	—	—	—	—	—	—	—	—		—	2	1	Woolwich.
—	—	—	—	—	—	—	—	—	—	—		—	—	—	Plumstead.
—	—	—	—	—	—	—	—	—	—	—		—	—	—	Lee.
—	—	—	—	—	—	—	—	—	—	—		—	2	—	Port of London.

§ Including Inner Temple (population, 96). ‖ Including Tower of London (population, 868).

Sanitary Areas.		Population (1891).	SCARLET FEVER — Weekly Statement, 1st Quarter, 1900													
			Jan. 6.		Jan. 13.		Jan. 20.		Jan. 27.		Feb. 3.		Feb. 10.		Feb. 17.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
London (*Administrative County.*)		4,232,118	221	6	225	7	259	6	246	6	217	10	222	7	208	5
W. District.	Kensington	166,308	7	—	8	—	7	1	9	—	6	—	6	—	11	—
	Fulham	91,639	11	—	7	1	16	—	8	—	16	1	11	1	8	—
	Hammersmith	97,239	4	—	5	—	8	—	4	—	2	—	3	—	3	—
	Paddington	117,846	5	1	7	—	7	—	6	—	2	1	8	—	4	—
	Chelsea	96,253	1	—	7	1	5	—	4	—	6	—	5	1	6	—
	St George, Hanover Sq.*	78,599	2	—	7	—	2	—	2	—	2	—	2	—	3	—
	Westminster	55,539	2	—	1	—	1	—	3	—	2	1	1	—	2	—
	St. James, Westminster	24,995	—	—	1	—	—	—	—	—	—	—	—	—	—	—
N. District.	St. Marylebone	142,404	10	—	—	—	3	2	9	—	5	—	5	—	4	1
	Hampstead	68,416	5	—	2	1	3	—	8	—	3	—	5	—	2	—
	St. Pancras	234,379	8	—	4	—	17	—	13	1	6	—	4	—	5	—
	Islington	319,143	13	—	11	—	13	1	16	2	24	2	28	—	12	1
	St. Mary, Stoke Newington	30,936	2	—	3	1	1	—	1	—	3	—	2	—	2	—
	Hackney	198,606	15	1	7	—	21	—	12	—	11	1	16	—	17	2
Central District.	St. Giles and St. George, Bloomsbury.	39,782	1	—	1	—	1	—	—	—	1	—	2	—	1	—
	St. Martin-in-the-Fields	14,616	—	—	1	—	—	—	—	—	—	—	—	—	—	—
	Strand†	25,217	—	—	—	—	—	—	3	—	—	—	—	—	—	—
	Holborn‡	34,043	—	—	1	—	—	—	3	—	1	—	1	—	—	—
	Clerkenwell	66,216	—	—	2	—	—	—	4	—	1	1	2	—	—	—
	St. Luke, Middlesex	42,440	1	—	2	—	4	—	—	—	—	—	1	—	1	—
	London, City of§	37,583	1	—	—	—	1	—	—	—	1	—	—	—	—	—
E. District.	Shoreditch	124,009	10	1	5	—	6	1	5	1	5	—	3	—	6	—
	Bethnal Green	129,132	6	—	14	—	5	—	4	—	7	—	6	—	1	—
	Whitechapel‖	74,420	1	—	5	—	4	—	7	—	6	—	1	—	5	—
	St. George-in-the-East	45,795	2	—	—	—	—	—	—	—	1	—	2	—	1	—
	Limehouse	57,376	3	1	3	1	2	—	4	—	2	—	—	—	1	—
	Mile End Old Town	107,592	—	—	6	—	4	—	2	1	6	—	4	—	6	—
	Poplar	166,748	12	1	11	—	6	—	3	1	5	—	7	—	13	—
S. District.	St. Saviour, Southwark	27,177	—	—	4	—	1	—	—	—	2	—	—	—	—	—
	St. George, Southwark	59,712	2	—	3	—	1	1	1	—	3	—	1	—	2	—
	Newington	115,804	4	—	9	—	7	—	7	—	2	—	1	—	6	—
	St. Olave, Southwark	12,723	1	—	—	—	1	—	—	—	—	—	—	—	—	—
	Bermondsey	84,682	9	—	5	1	6	—	8	—	4	—	4	—	5	1
	Rotherhithe	39,255	3	1	—	—	1	—	5	—	2	—	1	—	2	—
	Lambeth	275,203	6	—	12	—	15	—	12	—	20	1	22	2	9	—
	Battersea	150,558	3	—	4	—	13	—	9	—	9	—	7	—	16	—
	Wandsworth	156,942	17	—	20	—	27	—	13	—	11	—	10	1	19	—
	Camberwell	235,344	16	—	11	—	17	—	21	—	9	—	23	—	9	—
	Greenwich	165,413	18	—	14	1	14	—	14	—	14	1	10	1	11	—
	Lewisham	92,647	8	—	3	—	6	—	10	—	7	1	8	1	5	—
	Woolwich	40,848	—	—	—	—	3	—	1	—	1	—	2	—	3	—
	Plumstead	52,436	12	—	14	—	7	—	14	—	7	—	4	—	2	—
	Lee	36,103	—	—	5	—	3	—	1	—	2	—	4	—	5	—
	Port of London	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

* Including St. Peter's, Westminster (population, 235). † Including Middle Temple (population, 95).
‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).

SCARLET FEVER—*continued.*

Feb. 24. Cases.	Feb. 24. Deaths.	Mar. 3. Cases.	Mar. 3. Deaths.	Mar. 10. Cases.	Mar. 10. Deaths.	Mar. 17. Cases.	Mar. 17. Deaths.	Mar. 24. Cases.	Mar. 24. Deaths.	Mar. 31. Cases.	Mar. 31. Deaths.	Totals for 1st Quarter, 1900. Cases.	Totals for 1st Quarter, 1900. Deaths.	Sanitary Areas.
Weekly Statement, 1st Quarter, 1900—*continued.*														
185	4	202	9	191	8	254	6	226	3	206	7	2,862	84	London. (*Administrative County.*)
5	—	13	—	7	—	3	—	4	—	7	—	93	1	Kensington.
13	—	2	—	3	—	16	—	7	—	6	—	124	3	Fulham.
7	—	9	—	—	—	3	—	5	—	4	—	57	—	Hammersmith.
4	1	4	—	2	—	6	—	2	—	3	—	60	3	Paddington.
1	—	2	—	2	1	9	—	4	—	2	—	54	3	Chelsea.
1	—	6	—	3	—	6	—	5	—	8	1	49	1	St. George, Hanover Sq.*
2	—	—	—	3	—	3	—	3	—	2	—	25	1	Westminster.
1	—	—	—	—	—	1	—	3	—	—	—	6	—	St. James, Westminster.
7	—	5	—	1	1	4	—	4	—	2	—	59	4	St. Marylebone.
2	—	3	1	5	—	4	—	5	—	5	—	52	2	Hampstead.
6	—	5	1	6	—	9	—	2	—	6	1	91	3	St. Pancras.
8	—	19	1	19	1	24	—	14	—	23	—	224	8	Islington.
4	—	1	—	4	—	3	—	3	—	2	1	31	2	St. Mary, Stoke Newington
7	—	6	1	12	—	14	1	11	1	11	1	160	8	Hackney.
1	—	—	—	—	—	—	—	1	—	—	—	9	—	St. Giles and St. George, Bloomsbury.
—	—	—	—	—	—	1	—	1	—	—	—	3	—	St. Martin-in-the-Fields.
1	—	—	—	—	—	—	—	1	—	—	—	5	—	Strand.†
—	—	2	—	—	—	2	—	1	—	—	—	11	—	Holborn.‡
—	—	4	1	3	1	1	1	1	—	—	—	18	4	Clerkenwell.
—	—	—	—	—	—	—	—	1	—	1	—	11	—	St. Luke, Middlesex.
—	—	1	—	1	—	1	—	1	—	—	—	7	—	London, City of.§
4	1	4	—	3	1	6	—	5	—	7	—	69	5	Shoreditch.
2	—	4	—	3	1	7	—	6	—	8	—	73	1	Bethnal Green.
3	—	4	1	2	—	7	—	7	—	10	1	62	2	Whitechapel.‖
—	—	1	—	4	—	—	—	3	—	2	—	16	—	St. George-in-the-East.
1	—	4	—	2	—	3	—	—	—	1	—	26	2	Limehouse.
2	—	5	—	5	—	5	—	2	—	2	—	49	1	Mile End Old Town.
1	—	3	—	9	—	7	—	10	—	5	—	92	2	Poplar.
1	—	1	—	—	—	3	—	1	—	1	—	14	—	St. Saviour, Southwark.
6	—	3	—	1	—	2	1	4	—	4	1	33	3	St. George, Southwark.
7	—	6	—	5	—	4	1	5	—	4	—	67	1	Newington.
1	—	2	—	—	—	2	—	3	—	—	—	10	—	St. Olave, Southwark.
1	—	5	—	9	—	3	—	4	—	7	—	70	2	Bermondsey.
2	—	1	—	8	—	1	—	3	—	—	—	29	1	Rotherhithe.
16	—	12	—	12	—	11	—	12	—	16	—	175	3	Lambeth.
12	—	5	1	7	—	6	—	14	1	16	—	121	2	Battersea.
10	—	17	1	7	1	19	—	12	—	14	—	196	3	Wandsworth.
12	1	13	—	11	—	20	1	16	1	8	—	186	3	Camberwell.
11	—	11	—	11	1	13	—	13	—	6	1	160	5	Greenwich.
6	—	8	—	8	—	15	1	7	—	4	—	95	3	Lewisham.
5	1	7	1	2	—	6	—	5	—	3	—	38	2	Woolwich.
8	—	3	—	9	—	3	—	11	—	5	—	99	—	Plumstead.
4	—	1	—	2	—	1	—	4	—	1	—	33	—	Lee.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Port of London.

§ Including Inner Temple (population, 96).　　‖ Including Tower of London (population, 866)

	Sanitary Areas.	Population (1891).	Scarlet Fever—*continued.* Weekly Statement, 2nd Quarter, 1900.													
			April 7.		April 14.		April 21.		April 28.		May 5.		May 12.		May 19.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
	London .. .. (*Administrative County.*)	4,232,118	242	7	218	8	217	5	217	11	238	4	256	4	254	6
W. District.	Kensington	166,308	13	—	5	—	4	—	3	—	1	—	11	—	6	—
	Fulham	91,639	6	—	7	1	9	—	10	2	14	1	6	—	5	—
	Hammersmith	97,239	3	—	4	—	—	—	3	—	5	—	6	—	5	—
	Paddington	117,846	3	—	1	—	4	—	5	—	—	—	7	—	1	—
	Chelsea..	96,253	7	—	3	—	2	—	4	—	5	—	2	—	3	—
	St. George, Hanover Sq.* ..	78,599	3	1	4	1	1	—	2	—	—	—	3	1	6	—
	Westminster	55,539	2	—	4	—	2	—	2	—	—	—	3	—	5	—
	St. James, Westminster ..	24,995	1	—	3	—	1	—	1	—	—	—	2	—	—	—
N. District.	St. Marylebone	142,404	4	—	3	1	5	—	8	—	9	1	9	—	3	—
	Hampstead	68,416	4	—	8	—	4	—	2	—	2	—	6	—	1	—
	St. Pancras	234,379	9	—	7	1	5	—	11	—	7	—	5	—	8	—
	Islington	319,143	18	—	27	2	11	—	12	—	11	—	24	1	21	—
	St Mary, Stoke Newington	30,936	2	—	—	—	1	1	1	—	2	—	—	—	4	—
	Hackney	198,606	9	1	10	—	13	—	11	2	16	—	7	—	11	—
Central District.	St. Giles and St. George, Bloomsbury.	39,782	3	—	—	—	1	—	1	—	2	—	1	—	4	—
	St. Martin-in-the-Fields ..	14,616	2	—	—	—	1	—	—	—	—	—	1	—	—	—
	Strand†	25,217	2	—	—	—	—	—	2	—	—	—	—	—	2	—
	Holborn‡	34,043	3	—	1	—	1	—	—	1	1	—	—	—	2	—
	Clerkenwell	66,216	1	—	—	—	1	—	4	—	1	—	5	—	1	—
	St. Luke, Middlesex ..	42,440	2	—	3	—	2	—	3	—	2	—	2	—	3	—
	London, City of§	37,583	—	—	2	—	1	—	—	—	—	—	3	—	2	—
E. District.	Shoreditch	124,009	6	—	8	—	7	1	5	1	6	—	6	—	13	1
	Bethnal Green	129,132	5	—	4	—	9	—	10	—	6	—	9	—	5	1
	Whitechapel‖	74,420	14	1	9	—	8	1	10	—	15	—	6	1	10	—
	St. George-in-the-East ..	45,795	1	—	1	—	1	—	4	—	8	—	6	—	5	—
	Limehouse	57,376	1	—	3	—	3	—	3	1	—	—	7	—	1	—
	Mile End Old Town ..	107,592	1	—	3	—	6	—	10	—	6	—	7	—	15	—
	Poplar	166,748	6	1	7	—	4	—	6	—	4	—	6	—	7	—
S. District.	St. Saviour, Southwark ..	27,177	3	—	—	—	—	—	2	—	1	—	2	—	2	—
	St. George, Southwark ..	59,712	7	1	8	—	2	—	2	—	6	—	6	—	5	—
	Newington	115,804	6	—	2	—	7	—	5	—	8	—	10	—	13	2
	St. Olave, Southwark ..	12,723	—	—	—	—	—	—	—	—	—	—	1	—	—	—
	Bermondsey	84,682	3	—	9	—	4	—	8	—	7	—	3	—	7	1
	Rotherhithe	39,255	2	—	1	—	3	—	—	1	2	—	—	—	2	1
	Lambeth	275,203	17	—	8	—	16	1	12	—	23	—	13	1	12	—
	Battersea	150,558	9	—	9	—	8	—	12	—	13	—	13	—	13	—
	Wandsworth	156,942	23	1	13	1	13	—	12	1	12	—	14	—	9	—
	Camberwell	235,344	11	—	13	1	18	—	7	—	15	—	12	—	13	—
	Greenwich	165,413	17	—	13	—	20	—	11	—	9	—	17	—	9	—
	Lewisham	92,617	8	1	5	—	3	—	1	1	10	—	7	—	9	—
	Woolwich	40,848	1	—	4	—	8	1	8	—	5	2	4	—	3	—
	Plumstead	52,433	2	—	4	—	7	—	3	1	3	—	4	—	6	—
	Lee	36,103	2	—	2	—	1	—	1	—	1	—	—	—	2	—
	Port of London	--	—	—	—	—	—	—	—	—	—	—	—	—	—	—

* Including St. Peter's, Westminster (population, 235). † Including Middle Temple (population, 95).
‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).

SCARLET FEVER—*continued.*												
Weekly Statement, 2nd Quarter, 1900—*continued.*										Totals for 2nd Quarter, 1900.		Sanitary Areas.
June 2.		June 9.		June 16.		June 23.		June 30.				
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
259	7	262	11	270	5	291	9	282	12	3,277	97	London. (*Administrative County.*)
8	—	4	—	5	—	10	—	10	—	85	—	Kensington.
11	—	7	1	4	—	11	1	11	1	115	7	Fulham.
2	—	4	—	6	1	9	—	7	1	60	2	Hammersmith.
1	—	3	—	4	—	8	—	9	—	49	—	Paddington.
8	—	5	—	7	—	8	—	5	—	64	—	Chelsea.
6	—	2	—	3	—	7	—	5	1	48	4	St. George, Hanover Sq.*
—	—	3	—	3	—	5	—	3	—	34	—	Westminster.
1	—	—	—	4	—	—	—	1	—	16	—	St. James, Westminster.
5	—	8	—	11	—	6	1	14	—	93	3	St. Marylebone.
6	—	4	—	4	—	3	—	1	—	50	—	Hampstead.
14	—	15	1	13	—	15	—	13	1	131	3	St. Pancras.
10	1	16	1	12	2	20	1	14	—	212	10	Islington.
3	—	1	—	1	—	1	—	2	—	19	1	St. Mary, Stoke Newington.
12	2	23	—	17	—	17	1	21	—	180	6	Hackney.
2	—	—	—	2	—	—	—	1	—	18	—	St. Giles and St. George, Bloomsbury.
1	—	—	—	—	—	—	—	1	—	6	—	St. Martin-in-the-Fields.
2	—	1	—	—	—	1	—	2	—	12	—	Strand.†
1	—	2	—	—	—	3	—	4	—	21	1	Holborn.‡
3	1	3	—	5	—	6	—	4	2	39	3	Clerkenwell.
2	—	4	1	4	—	4	—	2	—	33	1	St. Luke, Middlesex.
2	—	3	1	3	—	1	1	—	—	24	3	London, City of.§
4	—	5	—	13	—	5	2	2	1	85	7	Shoreditch.
11	—	8	—	11	—	13	—	9	1	105	2	Bethnal Green.
14	—	13	—	13	—	9	—	15	1	146	4	Whitechapel.‖
8	—	3	1	4	—	7	—	3	—	59	1	St. George-in-the-East.
5	—	6	1	4	—	9	—	3	1	51	3	Limehouse.
12	—	5	—	10	—	7	—	10	2	103	2	Mile End Old Town.
6	—	7	—	15	—	8	—	5	—	83	1	Poplar.
4	—	1	—	2	—	—	—	2	—	22	—	St. Saviour, Southwark.
4	—	6	1	3	—	5	1	9	—	72	4	St. George, Southwark.
10	—	8	—	5	—	6	—	5	—	89	2	Newington.
—	—	5	—	—	—	3	—	1	—	12	—	St. Olave, Southwark.
3	—	2	—	5	—	5	—	6	—	67	1	Bermondsey.
1	—	4	—	1	1	1	—	2	—	19	3	Rotherhithe.
13	2	17	1	8	—	18	—	13	—	186	5	Lambeth.
7	—	12	1	8	—	11	—	14	—	142	3	Battersea.
12	—	9	—	13	—	6	1	6	—	157	4	Wandsworth.
18	—	21	—	12	—	18	—	12	—	178	1	Camberwell.
8	—	12	1	16	—	13	—	14	—	173	2	Greenwich.
5	—	1	—	14	—	4	—	11	—	84	2	Lewisham.
3	—	2	—	—	—	1	—	4	—	47	3	Woolwich.
8	1	5	—	4	1	4	—	6	—	67	3	Plumstead.
3	—	2	—	1	—	3	—	—	—	20	—	Lee.
—	—	—	—	—	—	—	—	—	—	1	—	Port of London.

...ding Inner Temple (population, 96).   Including Tower of London (population, 868)

District	Sanitary Areas.	Population (1891).	SCARLET FEVER—*continued.* Weekly Statement, 3rd Quarter, 1900. July 7. Cases.	July 7. Deaths.	July 14. Cases.	July 14. Deaths.	July 21. Cases.	July 21. Deaths.	July 28. Cases.	July 28. Deaths.	Aug. 4. Cases.	Aug. 4. Deaths.	Aug. 11. Cases.	Aug. 11. Deaths.	Aug. 18. Cases.	Aug. 18. Deaths.
	London .. .. (*Administrative County.*)	4,232,118	283	10	240	4	254	5	226	6	195	5	193	6	195	4
W. District.	Kensington	166,308	6	1	6	—	6	—	7	—	5	—	3	—	6	—
	Fulham	91,639	13	2	8	—	17	—	7	—	6	—	5	—	3	—
	Hammersmith	97,239	7	—	6	—	2	—	5	—	4	—	4	—	8	—
	Paddington	117,846	5	—	14	—	8	—	5	—	2	—	7	—	8	—
	Chelsea..	96,253	7	—	8	—	5	—	1	—	4	—	3	1	—	—
	St. George, Hanover Sq.* ..	78,599	4	—	4	—	2	1	6	—	3	—	—	—	1	—
	Westminster	55,539	4	—	3	—	3	—	2	—	2	—	3	—	—	—
	St. James, Westminster ..	24,995	2	—	3	—	1	—	—	—	2	—	1	1	—	—
N. District.	St. Marylebone	142,404	9	—	3	—	8	—	6	—	6	—	3	—	2	—
	Hampstead	68,416	2	—	3	—	8	—	2	—	6	—	4	1	2	—
	St. Pancras	234,379	12	1	6	—	16	—	15	—	17	—	13	—	12	—
	Islington	319,143	23	—	14	1	17	—	26	—	15	—	13	1	13	—
	St. Mary, Stoke Newington	30,936	1	1	6	—	4	—	3	—	—	—	3	—	2	—
	Hackney	198,606	17	—	12	—	9	—	11	—	7	1	14	—	6	—
Central District.	St. Giles and St. George, Bloomsbury.	39,782	1	—	2	—	1	—	1	—	2	—	1	—	—	—
	St. Martin-in-the-Fields ..	14,616	1	—	—	—	1	—	1	—	—	—	—	—	—	—
	Strand†	25,217	3	—	1	—	—	—	2	—	—	—	—	—	3	—
	Holborn‡	34,043	4	—	—	—	1	—	9	—	1	—	3	—	1	1
	Clerkenwell	66,216	4	—	5	—	—	—	3	1	1	—	4	—	2	—
	St. Luke, Middlesex ..	42,440	2	—	3	—	2	—	3	—	1	—	2	—	3	—
	London, City of§	37,583	2	—	—	—	2	—	3	—	—	—	1	—	2	—
E. District.	Shoreditch	124,009	5	—	6	—	7	—	2	1	5	—	5	—	6	—
	Bethnal Green	129,132	5	1	7	1	4	—	8	1	4	—	7	1	6	1
	Whitechapel‖	74,420	11	—	8	—	11	1	10	—	10	—	20	—	12	—
	St. George-in-the-East ..	45,795	2	1	3	—	5	—	3	2	3	—	3	—	6	—
	Limehouse	57,376	2	2	3	—	1	1	1	—	4	—	1	—	4	—
	Mile End Old Town ..	107,592	11	—	8	—	4	—	7	—	4	1	3	—	6	—
	Poplar	166,748	6	—	6	—	11	—	6	—	7	—	4	—	10	—
S. District.	St. Saviour, Southwark ..	27,177	4	—	1	—	3	—	1	—	1	—	—	—	3	—
	St. George, Southwark ..	59,712	3	—	6	—	6	—	4	—	1	—	1	—	5	—
	Newington	115,804	6	1	8	—	6	—	3	—	5	1	6	—	5	—
	St. Olave, Southwark ..	12,723	3	—	2	—	—	—	—	—	2	—	—	—	1	—
	Bermondsey	84,682	5	—	5	—	1	1	2	—	3	1	2	—	3	—
	Rotherhithe	39,255	1	—	1	—	2	—	2	—	2	—	1	—	6	—
	Lambeth	275,203	12	—	16	2	18	—	14	—	11	—	11	—	9	—
	Battersea	150,558	11	—	3	—	16	—	8	—	7	—	8	—	4	1
	Wandsworth	156,942	8	—	5	—	9	—	7	—	7	—	9	—	11	1
	Camberwell	235,344	26	—	12	—	7	—	13	—	16	—	8	—	8	—
	Greenwich	165,413	5	—	7	—	12	—	4	1	7	—	4	—	5	—
	Lewisham	92,647	13	—	5	—	6	—	2	—	5	—	6	1	5	—
	Woolwich	40,848	—	—	5	—	1	—	4	—	2	—	1	—	1	—
	Plumstead	52,436	12	—	8	—	7	1	2	—	4	1	4	—	3	—
	Lee	36,103	2	—	8	—	4	—	5	—	1	—	2	—	2	—
	Port of London	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—

* Including St. Peter's, Westminster (population, 235). † Including Middle Temple (population, 95).
‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136).
Staple Inn (population, 21), and Furnival's Inn (population, 121).

SCARLET FEVER—*continued.*

Weekly Statement, 3rd Quarter, 1900—*continued.*												Totals for 3rd Quarter, 1900.		Sanitary Areas.
Aug. 25.		Sept. 1.		Sept. 8.		Sept. 15.		Sept. 22.		Sept. 29.				
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
191	10	205	5	237	4	302	3	306	3	391	5	3,218	70	London. (*Administrative County.*)
6	—	6	—	5	—	8	—	8	—	8	—	80	1	Kensington.
3	—	4	—	13	2	4	—	8	—	19	—	110	4	Fulham.
6	—	1	—	12	—	11	—	8	1	15	—	89	1	Hammersmith.
11	—	7	—	4	—	5	—	4	—	8	—	88	—	Paddington.
2	1	1	—	3	—	5	—	2	1	14	—	55	3	Chelsea.
1	—	1	—	1	—	1	—	2	—	2	—	28	1	St. George, Hanover Sq.*
1	—	1	—	1	—	2	—	2	—	7	—	31	—	Westminster.
2	—	2	—	—	—	1	—	2	—	1	—	17	1	St. James, Westminster.
5	—	7	—	8	—	4	—	6	—	13	—	80	—	St. Marylebone.
1	—	3	—	2	—	8	—	8	—	4	—	53	1	Hampstead
12	—	6	—	14	—	19	—	21	—	20	—	183	1	St. Pancras.
12	—	16	—	17	—	21	—	28	—	23	1	238	3	Islington.
—	—	2	—	—	—	2	—	3	—	4	—	30	1	St. Mary, Stoke Newington.
7	3	9	—	4	—	21	—	11	—	19	—	147	4	Hackney.
2	—	—	—	3	—	3	—	5	—	5	—	26	—	St. Giles and St. George, Bloomsbury.
—	—	—	—	—	—	—	—	1	—	1	—	5	—	St. Martin-in-the-Fields.
—	—	1	—	1	—	—	—	1	—	—	—	12	—	Strand.†
3	—	2	—	4	—	4	1	2	—	5	—	39	2	Holborn.‡
2	—	2	—	4	1	5	—	1	—	2	—	35	2	Clerkenwell.
1	1	1	—	1	—	5	—	4	—	3	—	31	1	St. Luke, Middlesex.
—	—	3	—	1	—	1	—	3	—	5	—	23	—	London, City of.§
6	—	6	1	10	—	7	—	6	—	9	—	80	2	Shoreditch.
4	—	7	—	8	—	7	—	9	—	15	1	91	6	Bethnal Green.
8	—	11	—	6	—	8	—	5	—	6	1	126	2	Whitechapel.‖
3	—	2	1	1	—	3	—	3	—	3	—	40	4	St. George-in-the-East.
5	—	3	—	3	—	2	—	4	1	8	—	40	4	Limehouse.
11	—	16	1	5	—	9	—	7	—	3	—	94	2	Mile End Old Town.
4	—	8	—	8	—	13	—	14	—	11	—	106	—	Poplar.
2	—	2	—	1	—	5	—	2	—	2	—	27	—	St. Saviour, Southwark.
3	—	5	—	3	—	10	—	8	—	12	1	67	1	St. George, Southwark.
8	—	4	—	5	—	8	—	8	—	9	—	81	2	Newington.
1	1	—	—	—	—	1	—	—	—	2	—	12	1	St. Olave, Southwark.
5	—	4	1	3	—	3	—	4	—	5	—	45	3	Bermondsey.
3	1	4	—	2	—	8	—	2	—	3	—	37	1	Rotherhithe.
14	1	12	—	15	—	17	—	31	—	17	—	197	3	Lambeth.
6	1	4	—	8	—	17	—	15	—	18	—	125	2	Battersea.
7	—	7	—	13	1	13	—	14	—	17	—	127	2	Wandsworth.
3	—	9	—	21	—	12	1	13	—	26	1	174	2	Camberwell.
4	—	8	—	11	—	12	1	9	—	18	—	106	2	Greenwich.
9	1	8	1	3	—	5	—	8	—	15	—	90	3	Lewisham.
4	—	3	—	2	—	1	—	—	—	2	—	26	—	Woolwich.
1	—	1	—	7	—	5	—	9	—	8	—	71	2	Plumstead.
3	—	7	—	4	—	6	—	4	—	4	—	52	—	Lee.
—	—	—	—	—	—	—	—	1	—	—	—	2	—	Port of London.

§ Including Inner Temple (population, 96). ‖ Including Tower of London (population, 863).

	Sanitary Areas.	Population (1891).	SCARLET FEVER - *continued.* Weekly Statement, 4th Quarter, 1900. Oct. 6.		Oct. 13.		Oct. 20.		Oct. 27.		Nov. 3.		Nov. 10.		Nov. 17.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
	London .. .. (*Administrative County.*)	4,232,118	349	14	385	7	416	8	426	10	407	8	363	8	365	8
W. District.	Kensington	166,308	1	—	9	—	11	—	10	—	10	—	11	1	8	—
	Fulham	91,639	8	—	14	—	18	—	25	3	27	—	10	1	17	—
	Hammersmith	97,239	15	—	10	1	14	—	9	—	19	—	17	—	10	—
	Paddington	117,846	6	—	4	—	13	—	9	—	12	—	7	—	9	—
	Chelsea	96,253	3	—	9	—	6	—	3	—	7	1	8	—	1	—
	St. George, Hanover Sq.* ..	78,599	1	—	5	—	5	—	3	—	1	—	2	—	5	—
	Westminster	55,539	3	—	1	—	3	—	2	—	2	—	3	—	2	—
	St. James, Westminster ..	24,995	1	—	1	—	2	—	1	—	1	—	4	—	1	—
N. District.	St. Marylebone	142,404	12	—	4	—	11	—	19	—	16	—	16	—	16	—
	Hampstead	68,416	2	—	6	—	10	—	11	—	7	—	2	—	8	—
	St. Pancras	234,379	34	—	12	—	23	1	26	1	22	—	20	—	25	—
	Islington	319,143	31	—	33	—	29	—	37	1	35	1	27	1	43	—
	St. Mary, Stoke Newington	30,936	1	—	1	—	2	—	6	—	3	—	6	—	2	—
	Hackney	198,606	17	—	24	1	22	—	22	—	24	—	6	—	16	—
Central District.	St. Giles and St. George, Bloomsbury.	39,782	10	1	2	1	3	1	4	—	2	—	4	—	4	—
	St. Martin-in-the-Fields ..	14,616	1	—	—	—	1	—	1	—	—	—	—	—	2	—
	Strand †	25,217	1	—	2	—	3	—	13	—	9	—	4	—	—	—
	Holborn ‡	34,043	3	1	2	—	2	—	3	—	6	—	—	—	3	—
	Clerkenwell	66,216	5	1	6	—	2	—	6	—	3	—	5	—	—	—
	St. Luke, Middlesex ..	42,440	—	—	3	—	4	—	2	—	1	—	1	—	4	—
	London, City of §	37,583	4	—	2	—	6	1	2	—	4	—	3	—	1	—
E. District.	Shoreditch	124,009	8	1	12	—	7	—	7	—	2	—	11	—	3	—
	Bethnal Green	129,132	7	—	7	—	9	—	16	—	7	—	5	1	6	—
	Whitechapel ‖	74,420	5	—	10	—	8	—	7	1	3	—	6	1	8	1
	St. George-in-the-East ..	45,795	3	—	9	1	1	—	4	—	—	—	—	—	1	—
	Limehouse	57,376	2	—	6	—	7	—	11	—	8	2	5	—	5	—
	Mile End Old Town ..	107,592	6	—	10	—	10	—	2	—	10	1	9	—	4	1
	Poplar	166,748	12	1	13	—	19	1	22	—	23	1	24	1	20	—
S. District.	St. Saviour, Southwark ..	27,177	1	—	1	—	2	—	2	—	2	—	1	—	1	—
	St. George, Southwark ..	59,712	10	—	16	—	9	2	7	—	2	1	4	—	3	—
	Newington	115,804	6	1	14	—	8	—	13	1	11	—	7	1	13	1
	St. Olave, Southwark ..	12,723	1	—	1	—	1	—	—	—	—	—	—	—	—	—
	Bermondsey	84,682	8	—	6	—	6	—	8	—	4	—	10	1	8	—
	Rotherhithe	39,255	3	—	1	1	2	—	2	—	2	—	1	—	2	—
	Lambeth	275,203	21	—	23	1	28	1	26	—	14	1	26	—	23	3
	Battersea	150,558	13	1	20	—	18	—	14	1	8	—	18	—	11	—
	Wandsworth	156,942	10	3	9	—	14	—	6	1	20	—	20	—	21	2
	Camberwell	235,344	26	3	31	—	34	—	21	—	32	—	20	—	21	—
	Greenwich	165,413	18	—	19	1	19	1	17	1	21	—	20	—	17	—
	Lewisham	92,647	16	—	14	—	12	—	14	—	15	—	15	—	7	—
	Woolwich	40,848	3	—	—	—	4	—	3	—	5	—	—	—	4	—
	Plumstead	52,436	8	1	8	—	4	—	9	—	4	—	4	—	6	—
	Lee	36,103	2	—	5	—	4	—	1	—	3	—	1	—	4	—
	Port of London	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—

* Including St. Peter's, Westminster (population, 235). † Including Middle Temple (population, 95).
‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).

SCARLET FEVER—*continued.*

...ekly Statement, 4th Quarter, 1900—*continued.*											Totals for 4th Quarter, 1900.		Grand Totals for Year, 1900.		Sanitary Areas.
4.	Dec. 1.		Dec. 8.		Dec. 15.		Dec. 22.		Dec. 29.						
Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
1	337	6	334	11	303	8	264	4	198	7	4,440	110	13,797	361	London, (*Administrative County.*)
–	8	—	12	—	10	—	4	1	9	—	107	2	365	4	Kensington.
1	18	—	17	—	18	1	15	1	5	2	201	9	550	23	Fulham.
–	15	—	7	1	4	—	10	1	6	1	146	4	352	7	Hammersmith.
–	13	1	6	1	8	—	5	—	9	—	109	2	306	5	Paddington.
–	2	—	3	—	1	—	9	—	6	—	60	1	233	7	Chelsea.
–	4	—	2	—	9	—	1	—	1	—	42	—	167	6	St. George, Hanover Sq.*
–	1	—	5	—	4	—	3	—	—	—	32	—	122	1	Westminster.
–	1	—	2	—	1	—	5	—	—	—	23	—	62	1	St. James, Westminster.
2	12	—	15	2	10	1	10	—	3	—	150	5	382	12	St. Marylebone.
–	5	—	7	—	2	—	3	—	3	1	69	1	224	4	Hampstead.
–	22	—	8	—	15	—	19	–	14	1	253	3	658	10	St. Pancras.
1	23	—	34	—	39	—	20	—	19	—	410	4	1,084	25	Islington.
–	6	—	7	—	5	—	3	—	1	—	46	—	126	4	St. Mary, Stoke Newington.
–	15	—	15	—	13	—	10	—	9	—	207	1	694	19	Hackney.
–	4	—	5	—	3	1	2	—	—	—	45	4	98	4	St. Giles and St. George. Bloomsbury.
–	—	—	1	—	1	—	1	—	—	—	10	—	24	—	St. Martin-in-the-Fields.
–	2	—	5	—	1	1	2	—	3	—	51	1	80	1	Strand.†
–	4	—	2	—	3	—	—	—	—	—	28	1	99	4	Holborn.‡
–	4	—	1	—	8	—	1	—	1	—	45	1	137	10	Clerkenwell.
–	2	—	—	—	1	—	1	—	1	—	20	—	95	2	St. Luke, Middlesex.
–	3	—	3	—	—	1	1	—	—	—	29	2	83	5	London, City of.§
1	6	—	16	—	6	—	5	—	3	—	94	2	328	16	Shoreditch.
–	7	—	9	—	9	1	10	1	4	—	101	3	370	12	Bethnal Green.
–	3	—	1	—	3	—	6	—	5	—	65	3	399	11	Whitechapel.
–	—	—	—	—	1	—	2	—	1	—	23	1	138	6	St. George-in-the-East.
–	2	1	2	—	3	—	1	—	2	1	55	4	172	13	Limehouse.
–	4	—	7	—	2	—	8	—	7	—	88	2	334	7	Mile End Old Town.
–	11	—	13	1	13	—	18	—	7	—	217	5	500	8	Poplar.
–	1	—	4	—	—	—	2	—	—	—	19	—	82	—	St. Saviour, Southwark.
–	4	—	7	—	4	—	4	—	4	—	79	3	251	11	St. George, Southwark.
1	7	—	10	—	6	—	7	—	4	1	119	6	356	11	Newington.
–	—	—	—	—	—	—	—	—	—	—	3	—	37	1	St. Olave, Southwark.
–	5	—	7	—	1	–	6	—	3	—	76	1	258	7	Bermondsey.
–	—	—	—	—	3	—	—	—	—	—	17	1	102	6	Rotherhithe.
1	22	1	19	1	23	1	14	—	9	–	263	10	821	21	Lambeth.
–	16	1	4	—	10	1	7	—	13	—	157	4	545	11	Battersea.
1	22	1	17	—	14	—	11	—	14	—	193	8	673	17	Wandsworth.
1	23	—	19	2	15	—	15	—	9	—	278	6	816	12	Camberwell.
1	24	1	20	1	17	—	14	—	16	—	246	6	685	15	Greenwich.
–	11	—	15	1	6	—	8	—	5	—	148	1	417	9	Lewisham.
1	—	—	1	—	2	—	—	—	—	–	22	1	133	6	Woolwich.
–	4	—	4	1	4	—	1	—	2	—	61	2	298	7	Plumstead.
–	1	—	2	—	5	—	—	—	—	—	32	—	137	—	Lee.
–	—	—	—	—	—	—	—	—	—	—	1	—	4	—	Port of London.

Including Inner Temple (population, 96). ‖ Including Tower of London (population, 868).

District	Sanitary Areas.	Population (1891).	DIPHTHERIA — Weekly Statement, 1st Quarter, 1900. Jan. 6. Cases.	Jan. 6. Deaths.	Jan. 13. Cases.	Jan. 13. Deaths.	Jan. 20. Cases.	Jan. 20. Deaths.	Jan. 27. Cases.	Jan. 27. Deaths.	Feb. 3. Cases.	Feb. 3. Deaths.	Feb. 10. Cases.	Feb. 10. Deaths.	Feb. 17. Cases.	Feb. 17. Deaths.
	London (Administrative County.)	4,232,118	267	55	248	49	238	40	283	36	260	45	281	51	197	35
W. District.	Kensington	166,308	12	—	6	1	6	1	11	—	4	1	10	—	6	1
	Fulham	91,639	4	3	8	3	2	2	6	—	7	2	15	—	10	—
	Hammersmith	97,239	2	1	3	1	2	—	4	—	2	—	6	2	8	1
	Paddington	117,846	5	1	5	2	4	1	1	—	4	2	4	—	2	—
	Chelsea	96,253	5	—	2	—	2	1	1	—	4	—	—	—	5	—
	St. George, Hanover Sq.*	78,599	2	2	3	1	4	—	2	1	1	—	—	—	2	—
	Westminster	55,539	—	—	2	1	2	2	3	—	—	—	1	—	4	—
	St. James, Westminster	24,995	2	—	—	—	—	—	3	1	—	—	—	—	1	—
N. District.	St. Marylebone	142,404	2	—	2	3	4	—	2	—	1	1	6	1	3	—
	Hampstead	68,416	4	1	1	—	2	1	2	—	3	—	4	3	1	1
	St. Pancras	234,379	9	2	5	2	10	—	14	1	15	2	13	1	11	—
	Islington	319,143	5	1	13	4	14	1	18	2	20	2	13	4	6	2
	St. Mary, Stoke Newington	30,936	3	—	—	—	1	—	1	—	—	—	1	—	1	—
	Hackney	198,606	11	3	19	2	10	2	11	1	14	3	12	3	9	1
Central District.	St. Giles and St. George, Bloomsbury.	39,782	—	—	—	—	—	—	—	—	3	1	2	—	1	—
	St. Martin-in-the-Fields	14,616	—	—	—	—	1	—	2	1	3	—	—	—	—	—
	Strand†	25,217	—	—	—	—	1	—	—	—	—	—	1	—	—	—
	Holborn‡	34,043	1	—	3	—	1	—	—	—	2	2	1	—	1	—
	Clerkenwell	66,216	3	1	4	—	3	—	2	—	4	1	6	—	3	1
	St. Luke, Middlesex	42,440	3	1	4	—	3	2	1	2	—	1	4	—	1	—
	London, City of§	37,583	—	—	—	—	1	—	—	—	1	—	3	—	—	—
E. District.	Shoreditch	124,009	13	2	2	3	6	—	5	1	7	1	3	1	2	1
	Bethnal Green	129,132	11	4	15	3	7	—	6	1	10	—	8	2	5	—
	Whitechapel‖	74,420	4	1	5	—	3	—	2	—	4	—	2	—	3	1
	St. George-in-the-East	45,795	1	..	2	—	2	—	2	—	1	1	—	—	2	—
	Limehouse	57,376	1	—	1	—	1	—	7	1	4	—	10	—	3	1
	Mile End Old Town	107,592	9	1	7	2	2	—	2	1	9	—	6	—	5	1
	Poplar	166,748	11	6	4	2	8	1	7	1	4	1	12	4	5	6
S. District.	St. Saviour, Southwark	27,177	5	1	—	—	3	—	1	—	5	—	7	1	3	1
	St. George, Southwark	59,712	11	2	2	2	10	—	4	1	7	1	5	1	6	—
	Newington	115,804	10	—	7	3	10	3	19	3	14	6	13	3	4	—
	St. Olave, Southwark	12,723	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Bermondsey	84,682	7	2	7	2	14	1	8	2	9	3	11	2	8	1
	Rotherhithe	39,255	3	2	2	2	1	—	4	—	1	—	2	2	1	1
	Lambeth	275,203	19	4	19	—	23	4	17	4	20	3	27	5	15	4
	Battersea	150,558	5	—	9	—	11	2	9	2	9	—	3	—	6	—
	Wandsworth	156,942	17	1	13	—	18	6	32	2	20	2	13	4	7	2
	Camberwell	235,344	27	6	33	2	23	7	29	6	19	6	27	6	23	4
	Greenwich	165,413	11	3	13	2	9	1	16	2	10	1	19	5	9	3
	Lewisham	92,647	7	—	13	3	8	1	13	—	11	2	5	—	4	—
	Woolwich	40,848	7	1	5	—	3	—	3	—	1	—	1	—	—	—
	Plumstead	52,436	10	2	7	1	2	—	9	—	3	—	2	—	7	1
	Lee	36,103	5	1	2	2	1	1	4	—	4	—	3	1	4	1
	Port of London	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

* Including St. Peter's, Westminster (population, 235). † Including Middle Temple (population, 96).
‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21). and Furnival's Inn (population, 121).

DIPHTHERIA—*continued.*

Weekly Statement, 1st Quarter, 1900—*continued.*												Totals for 1st Quarter, 1900.		Sanitary Areas.
Feb. 24.		Mar. 3.		Mar. 10.		Mar. 17.		Mar. 24.		Mar. 31.				
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
209	46	208	26	238	40	226	35	215	36	158	31	3,028	524	London. (*Administrative County.*)
2	—	6	—	6	1	10	1	8	—	6	1	93	7	Kensington.
8	5	11	—	8	—	12	—	13	2	14	2	118	19	Fulham.
8	2	5	—	9	2	4	1	4	2	3	1	60	13	Hammersmith.
1	—	3	1	2	—	5	2	1	—	2	1	39	10	Paddington.
3	1	1	—	3	—	2	—	4	2	—	—	32	4	Chelsea.
—	—	3	1	1	1	6	—	2	—	2	—	28	6	St. George, Hanover Sq.*
3	—	—	—	2	—	1	—	4	1	—	—	22	4	Westminster.
—	—	1	—	1	—	2	—	—	—	—	—	10	1	St. James, Westminster.
—	3	6	1	3	—	1	—	2	—	2	—	34	9	St. Marylebone.
2	—	2	—	4	—	—	—	2	—	1	1	28	7	Hampstead.
8	4	5	3	8	1	5	—	9	1	7	2	119	19	St. Pancras.
14	1	7	1	4	1	11	1	4	3	8	1	137	24	Islington.
1	—	1	—	3	—	2	—	—	—	3	1	17	1	St. Mary, Stoke Newington
6	1	12	1	8	2	14	1	6	2	11	1	143	23	Hackney.
—	—	—	—	—	—	—	—	1	—	1	—	8	1	St. Giles and St. George, Bloomsbury.
—	—	—	—	—	—	1	—	—	—	—	—	7	1	St. Martin-in-the-Fields.
1	—	—	—	—	—	—	—	—	—	1	—	4	—	Strand.†
2	—	1	—	3	—	3	—	1	1	—	—	19	3	Holborn.‡
2	—	3	—	—	1	4	1	2	—	2	—	38	5	Clerkenwell.
—	—	1	—	—	—	1	—	1	1	1	—	20	7	St. Luke, Middlesex.
1	—	4	1	1	1	—	—	5	1	—	1	16	4	London, City of.§
5	3	5	—	3	1	10	2	7	—	8	1	76	16	Shoreditch.
4	1	4	1	7	—	5	2	9	3	8	2	99	19	Bethnal Green.
4	1	4	—	5	1	3	—	2	—	5	2	46	6	Whitechapel.‖
3	—	1	—	1	—	1	—	3	1	—	—	19	2	St. George-in-the-East.
5	—	4	—	4	—	5	2	3	—	3	—	51	4	Limehouse.
3	1	3	—	2	2	4	—	7	2	1	—	59	10	Mile End Old Town.
6	1	8	3	8	4	7	2	4	3	7	2	91	36	Poplar.
5	—	2	—	3	—	2	—	4	—	1	—	41	3	St. Saviour, Southwark.
2	3	6	1	9	—	1	—	6	—	3	3	72	14	St. George, Southwark.
7	2	9	—	11	3	5	1	4	2	4	1	117	27	Newington.
—	—	—	—	—	—	—	—	1	1	—	—	1	1	St. Olave, Southwark.
6	4	6	1	9	4	9	—	10	—	7	2	111	24	Bermondsey.
4	—	4	1	5	1	1	—	3	—	1	—	32	9	Rotherhithe.
21	6	19	3	22	1	21	3	16	—	8	1	247	38	Lambeth.
10	1	8	1	13	1	6	1	9	—	5	—	103	8	Battersea.
6	—	10	1	13	1	11	3	9	—	2	—	171	22	Wandsworth.
25	3	16	2	23	6	20	4	18	2	9	1	292	55	Camberwell.
13	—	13	2	10	2	13	3	10	2	9	2	155	28	Greenwich.
8	2	7	—	8	2	5	4	3	—	3	—	95	14	Lewisham.
4	—	2	—	1	—	—	—	1	—	2	1	30	2	Woolwich.
4	—	—	—	7	—	10	—	12	3	2	—	75	7	Plumstead.
3	1	5	—	8	1	3	1	5	1	6	1	53	11	Lee.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Port of London.

§ Including Inner Temple (population, 96). ‖ Including Tower of London (population, 868)

Sanitary Areas.		Population (1891).	DIPHTHERIA—*continued.* Weekly Statement, 2nd Quarter, 1900.													
			April 7.		April 14.		April 21.		April 28.		May 5.		May 12.		May 19.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
London .. .. (*Administrative County.*)		4,232,118	184	31	155	19	188	17	199	20	220	20	238	29	229	22
W. District.	Kensington	166,308	6	—	6	—	7	2	12	—	12	—	7	—	2	—
	Fulham	91,639	13	1	9	—	9	3	2	1	7	—	14	—	8	—
	Hammersmith	97,239	4	—	4	—	2	—	4	—	5	1	2	—	5	—
	Paddington	117,846	3	—	2	—	—	—	7	—	5	—	1	2	4	—
	Chelsea..	96,253	4	1	6	1	7	1	5	—	5	—	5	—	4	1
	St. George, Hanover Sq.* ..	78,599	—	—	—	—	2	—	1	—	2	—	2	—	2	—
	Westminster	55,539	1	—	3	1	3	—	1	—	2	—	4	—	1	—
	St. James, Westminster ..	24,995	1	—	—	1	—	—	—	—	2	—	—	—	1	—
N. District.	St. Marylebone	142,401	4	2	—	1	2	—	4	—	5	1	6	2	11	1
	Hampstead	68,416	1	—	—	—	—	—	2	—	1	—	—	—	1	—
	St. Pancras	234,379	8	3	8	—	8	—	10	2	10	1	8	—	7	—
	Islington	319,143	5	2	7	1	10	—	4	2	11	4	13	3	18	4
	St. Mary, Stoke Newington	30,936	2	—	—	—	2	—	—	—	1	—	1	—	2	—
	Hackney	198,606	10	1	7	—	8	1	7	1	7	1	17	4	7	1
Central District.	St. Giles and St. George, Bloomsbury.	39,782	—	—	1	—	—	—	—	—	1	—	1	—	2	—
	St. Martin-in-the-Fields ..	14,616	—	—	—	—	—	—	—	—	1	—	—	—	—	—
	Strand †	25,217	—	—	—	—	1	—	—	—	—	—	—	—	2	—
	Holborn ‡	34,043	3	—	1	—	3	—	2	—	2	—	3	—	—	1
	Clerkenwell	66,216	2	—	2	1	—	—	—	—	4	—	3	—	1	—
	St. Luke, Middlesex ..	42,440	—	—	—	—	—	—	—	—	2	—	2	—	1	—
	London, City of §	37,583	1	—	1	—	1	—	1	—	—	—	1	—	3	—
E. District.	Shoreditch	124,009	3	1	8	—	3	1	6	2	6	—	6	2	5	—
	Bethnal Green	129,132	4	1	3	2	5	—	8	—	8	—	14	1	15	3
	Whitechapel ‖	74,420	5	1	5	—	7	1	5	—	3	—	1	—	10	—
	St. George-in-the-East ..	45,795	1	—	3	—	3	—	1	—	3	—	1	—	5	—
	Limehouse	57,376	5	1	2	—	—	—	2	—	3	—	1	—	2	—
	Mile End Old Town ..	107,592	3	1	4	—	5	—	2	—	5	—	4	—	7	2
	Poplar	166,748	7	1	8	—	1	1	2	1	5	—	8	—	11	1
S. District.	St. Saviour, Southwark ..	27,177	3	—	3	1	3	—	2	1	4	1	—	—	6	—
	St. George, Southwark ..	59,712	6	—	1	1	4	—	9	—	7	1	4	—	7	1
	Newington	115,804	9	1	1	—	5	1	8	—	9	1	16	4	8	1
	St. Olave, Southwark ..	12,723	1	—	—	—	—	—	1	—	1	—	1	—	—	—
	Bermondsey	84,682	6	2	9	2	7	1	7	—	11	1	11	1	6	—
	Rotherhithe	39,255	2	—	4	—	1	—	1	—	1	1	3	—	2	—
	Lambeth	275,203	8	2	12	1	21	1	15	2	25	2	22	3	11	3
	Battersea	150,558	7	—	5	1	8	1	5	1	4	—	—	1	10	1
	Wandsworth..	156,942	6	1	3	2	7	—	6	—	10	—	13	—	6	—
	Camberwell	235,344	13	3	7	1	13	2	28	2	17	2	14	2	11	1
	Greenwich	165,413	9	2	10	—	13	—	9	3	2	3	8	—	6	—
	Lewisham	92,647	6	3	6	—	6	—	6	2	7	—	12	2	5	1
	Woolwich	40,848	5	—	2	—	3	1	4	—	—	—	1	—	3	—
	Plumstead	52,436	6	—	2	2	6	—	8	—	4	—	7	2	10	—
	Lee	36,103	1	1	—	—	2	—	2	—	—	—	1	—	1	—
	Port of London	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

* Including St. Peter's, Westminster (population, 235). † Including Middle Temple (population, 95).
‡ Including Gray's Inn (population, 263), Lincoln's Inn (population 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).

DIPHTHERIA—*continued.*

Weekly Statement, 2nd Quarter, 1900—*continued.*												Totals for 2nd Quarter, 1900.		Sanitary Areas.
May 26.		June 2.		June 9.		June 16.		June 23.		June 30.				
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
230	29	217	29	117	24	182	27	201	21	196	29	2,616	317	London. (*Administrative County.*)
4	—	4	1	6	1	2	—	2	—	2	3	72	7	Kensington.
15	—	9	1	7	—	7	—	4	1	12	1	116	8	Fulham.
2	1	4	—	3	—	5	1	3	—	2	—	45	3	Hammersmith.
2	2	10	—	—	1	—	—	1	—	2	—	37	5	Paddington.
2	1	5	—	1	—	2	—	5	—	1	—	52	5	Chelsea.
2	1	1	—	2	—	1	—	—	—	—	—	15	1	St. George, Hanover Sq.*
1	—	1	—	1	—	1	—	4	—	2	1	25	2	Westminster.
3	—	2	1	—	—	—	—	2	—	4	1	15	3	St. James, Westminster.
5	—	2	—	2	—	2	—	5	—	6	1	54	8	St. Marylebone.
—	—	3	—	2	—	2	—	3	—	5	1	20	1	Hampstead.
9	2	14	6	10	1	8	—	14	—	16	3	130	18	St. Pancras.
11	2	9	1	11	2	12	3	10	5	10	1	131	30	Islington.
1	—	2	—	1	—	2	—	2	1	—	—	16	1	St. Mary, Stoke Newington.
18	1	9	1	6	2	6	—	7	1	10	2	119	16	Hackney.
2	—	2	1	1	—	1	—	1	1	—	—	12	2	St. Giles and St. George, Bloomsbury.
—	—	—	—	—	—	—	—	—	—	—	—	1	—	St Martin-in-the-Fields.
2	1	3	1	2	—	1	—	1	—	—	—	12	2	Strand.†
—	—	3	—	1	—	—	—	3	—	—	—	21	1	Holborn.‡
1	1	8	1	—	—	3	2	2	—	2	—	28	5	Clerkenwell.
6	—	1	—	1	—	—	1	—	—	6	—	19	1	St. Luke, Middlesex.
2	1	5	—	2	—	—	—	2	—	—	—	19	1	London, City of.§
6	1	5	2	8	1	6	2	12	—	13	4	87	16	Shoreditch.
9	—	5	—	8	4	7	3	14	4	10	3	110	21	Bethnal Green.
6	—	11	1	7	—	8	—	6	—	1	—	75	3	Whitechapel.‖
6	1	4	2	1	1	2	—	1	—	—	—	31	4	St. George-in-the-East.
4	—	4	2	7	—	9	—	4	1	5	—	48	4	Limehouse.
6	—	11	—	3	—	3	1	4	—	3	—	60	4	Mile End Old Town.
9	1	8	—	4	—	16	2	5	—	3	—	87	7	Poplar.
6	1	2	3	3	—	—	—	1	—	1	—	34	7	St. Saviour, Southwark.
5	—	1	—	4	—	3	—	2	—	4	—	57	3	St. George, Southwark.
7	2	5	1	11	2	6	1	10	—	10	2	105	16	Newington.
1	—	—	—	1	—	—	—	1	—	1	—	8	—	St. Olave, Southwark.
6	1	7	—	7	2	4	1	7	1	2	—	90	12	Bermondsey.
1	1	—	—	—	1	1	—	1	—	1	1	18	4	Rotherhithe.
19	5	14	1	12	3	19	4	15	1	17	1	210	29	Lambeth.
3	—	2	—	2	—	5	—	1	1	4	—	56	6	Battersea.
6	—	9	—	2	1	8	—	8	2	5	—	89	6	Wandsworth.
11	1	10	1	10	2	15	3	13	—	20	—	182	20	Camberwell.
9	1	8	—	13	—	4	2	8	—	5	2	104	13	Greenwich.
7	—	6	—	9	—	5	—	5	2	2	—	82	10	Lewisham.
2	—	2	—	—	—	1	1	1	—	—	—	24	2	Woolwich.
7	1	4	2	4	—	3	—	7	—	4	1	72	8	Plumstead.
5	—	2	—	2	—	2	—	4	—	5	1	27	2	Lee.
1	—	—	—	—	—	—	—	—	—	—	—	1	—	Port of London.

§ Including Inner Temple (population, 96). ‖ Including Tower of London (population, 868).

District	Sanitary Areas.	Population (1891).	DIPHTHERIA—*continued.* Weekly Statement, 3rd Quarter, 1900. July 7. Cases.	July 7. Deaths.	July 14. Cases.	July 14. Deaths.	July 21. Cases.	July 21. Deaths.	July 28. Cases.	July 28. Deaths.	Aug. 4. Cases.	Aug. 4. Deaths.	Aug. 11. Cases.	Aug. 11. Deaths.	Aug. 18. Cases.	Aug. 18. Deaths.
	London .. .. (*Administrative County.*)	4,232,118	220	19	211	26	256	21	253	27	230	23	178	25	203	17
W. District.	Kensington	166,308	5	—	2	—	12	—	3	—	7	—	3	—	3	1
	Fulham	91,639	15	1	15	2	11	1	12	1	9	—	5	1	14	2
	Hammersmith	97,239	5	1	3	—	4	—	2	—	13	—	3	—	1	—
	Paddington	117,846	—	—	3	—	5	—	1	1	—	—	3	1	3	—
	Chelsea..	96,253	2	—	6	1	1	—	9	1	3	1	1	—	—	—
	St. George, Hanover Sq.* ..	78,599	—	—	1	—	2	—	3	—	3	—	1	—	3	—
	Westminster	55,539	4	1	2	—	1	—	2	—	2	—	3	—	2	—
	St. James, Westminster ..	24,995	2	—	1	—	—	—	1	—	1	—	—	—	1	—
N. District.	St. Marylebone	142,404	2	—	6	—	3	1	11	2	9	1	3	3	2	—
	Hampstead	68,416	1	1	2	2	3	—	6	1	6	—	1	1	2	—
	St. Pancras	234,379	15	2	7	—	13	2	9	1	11	—	9	2	20	2
	Islington	319,143	14	2	7	3	9	2	12	2	9	1	14	1	6	—
	St. Mary, Stoke Newington	30,936	—	—	—	1	2	—	2	—	1	—	1	—	1	—
	Hackney	198,606	3	—	23	2	11	—	16	1	12	2	15	—	17	—
Central District.	St. Giles and St. George, Bloomsbury.	39,782	3	—	—	—	1	1	1	—	—	—	2	—	2	1
	St. Martin-in-the-Fields ..	14,616	1	—	1	—	1	—	—	—	—	1	—	—	—	—
	Strand†	25,217	1	—	3	—	—	1	2	—	1	—	—	—	2	—
	Holborn‡	34,043	1	—	2	—	—	—	2	—	2	—	3	—	—	—
	Clerkenwell	66,216	2	1	4	1	4	—	4	3	3	—	1	1	1	—
	St. Luke, Middlesex ..	42,440	—	—	2	—	2	1	2	—	2	1	—	—	—	—
	London, City of §	37,583	—	—	1	—	1	—	2	—	1	—	—	—	2	—
E. District.	Shoreditch	124,009	13	2	9	1	5	1	6	1	8	—	4	1	7	—
	Bethnal Green	129,132	6	2	9	2	12	—	12	1	7	1	6	—	8	—
	Whitechapel‖	74,420	6	—	6	—	10	1	13	—	7	3	7	—	12	1
	St. George-in-the-East ..	45,795	4	—	3	1	1	—	6	—	4	—	1	—	4	—
	Limehouse	57,376	3	—	3	—	1	1	2	—	1	—	3	—	1	—
	Mile End Old Town ..	107,592	4	—	2	—	7	—	6	1	8	—	—	—	9	—
	Poplar	166,748	12	1	8	1	13	—	11	1	13	1	22	5	8	1
S. District.	St. Saviour, Southwark ..	27,177	1	—	—	—	2	—	1	—	6	2	6	—	2	—
	St. George, Southwark ..	59,712	1	—	2	—	4	—	1	—	3	—	1	—	2	—
	Newington	115,804	10	1	5	1	9	1	14	—	6	—	5	2	10	2
	St. Olave, Southwark ..	12,723	—	1	—	—	—	—	—	—	—	—	—	—	1	—
	Bermondsey	84,682	3	—	2	—	—	—	3	—	5	1	5	1	5	1
	Rotherhithe	39,255	5	—	2	—	7	1	—	—	2	—	2	—	6	—
	Lambeth	275,203	24	—	23	3	34	7	25	3	14	—	12	1	16	1
	Battersea	150,558	6	—	7	1	3	—	3	—	7	4	3	—	5	3
	Wandsworth	156,942	6	—	7	—	8	—	9	1	12	—	6	—	4	1
	Camberwell	235,344	15	2	4	2	18	—	14	3	14	3	11	2	6	—
	Greenwich	165,413	7	1	13	1	11	—	13	2	6	1	3	—	9	1
	Lewisham	92,647	4	—	5	—	12	—	7	—	3	—	—	1	4	—
	Woolwich	40,848	1	—	2	—	—	—	2	—	1	—	2	—	—	—
	Plumstead	52,436	4	—	3	1	3	—	1	—	6	—	6	2	—	—
	Lee	36,103	8	—	5	—	10	—	2	1	2	—	3	—	—	—
	Port of London	—	1	—	—	—	—	—	—	—	—	—	2	—	2	—

* Including St. Peter's, Westminster (population, 235). † Including Middle Temple (population, 95).
‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population ,121).

DIPHTHERIA—*continued.*														
Weekly Statement, 3rd Quarter, 1900—*continued*												Totals for 3rd Quarter, 1900.		Sanitary Area.
Aug. 25.		Sept. 1.		Sept. 8.		Sept. 15.		Sept. 22.		Sept. 29.				
Cases	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
161	14	161	19	189	19	238	16	284	30	233	40	2,817	296	London. (*Administrative County.*)
4	1	2	—	8	—	4	—	3	—	9	—	65	2	Kensington.
10	4	1	—	10	—	14	1	16	2	17	4	149	19	Fulham.
1	—	6	1	5	1	2	—	5	1	10	2	60	6	Hammersmith.
4	—	1	1	4	1	1	1	2	—	—	—	27	5	Paddington.
1	—	—	1	4	—	7	1	8	—	4	1	46	6	Chelsea.
1	—	2	—	1	—	—	—	1	—	2	—	20	—	St. George, Hanover Sq.*
1	—	2	1	—	—	4	—	—	—	—	—	23	2	Westminster.
1	—	—	—	—	—	—	—	1	—	—	—	8	—	St. James, Westminster.
6	—	3	1	8	2	2	1	8	1	4	1	67	13	St. Marylebone.
6	—	—	—	1	—	3	—	5	3	2	3	38	11	Hampstead.
9	1	11	1	14	2	17	1	17	3	15	3	167	20	St. Pancras.
13	2	2	—	12	—	18	1	18	2	14	3	148	19	Islington.
2	—	1	—	1	—	—	—	6	—	1	—	18	1	St. Mary, Stoke Newington.
8	1	10	1	18	—	8	—	14	—	14	—	169	7	Hackney.
3	—	2	—	—	—	2	—	3	—	1	—	20	2	St. Giles and St. George, Bloomsbury.
1	—	—	—	—	—	—	—	—	—	—	—	4	1	St. Martin-in-the-Fields.
—	—	1	—	—	—	—	—	1	—	—	—	11	1	Strand.†
1	—	—	—	—	—	—	—	—	—	—	1	11	1	Holborn.‡
—	—	1	1	1	—	4	—	4	—	—	—	29	7	Clerkenwell.
—	—	—	—	1	—	4	—	—	1	1	—	14	3	St. Luke Middlesex.
3	—	1	—	—	—	2	—	5	—	1	—	19	—	London, City of.§
8	—	2	—	6	1	7	—	4	1	4	1	83	9	Shoreditch.
4	—	6	1	9	1	3	1	10	—	6	4	98	13	Bethnal Green.
4	—	4	—	—	—	5	—	3	—	5	1	82	6	Whitechapel.‖
7	1	2	—	2	—	1	—	6	—	4	2	45	4	St. George-in-the-East.
3	—	1	—	2	1	6	—	4	—	4	1	34	3	Limehouse.
7	—	10	—	6	—	14	1	11	3	4	—	88	5	Mile End Old Town.
4	—	19	4	9	2	18	4	21	3	14	4	172	27	Poplar.
—	—	1	—	—	—	1	—	—	—	2	—	22	2	St. Saviour, Southwark.
4	—	4	—	3	—	4	1	3	1	7	—	39	2	St. George, Southwark.
4	1	4	1	10	1	8	1	11	—	9	1	105	12	Newington.
—	—	—	—	—	—	—	—	—	—	—	—	1	1	St. Olave, Southwark.
4	1	4	—	4	2	7	—	7	2	9	—	58	8	Bermondsey.
1	—	3	2	1	—	3	—	1	1	3	1	36	6	Rotherhithe.
11	1	10	2	4	—	17	—	23	2	18	3	231	22	Lambeth.
2	—	3	—	6	—	8	—	8	—	5	—	66	9	Battersea.
3	—	2	—	5	1	4	—	4	—	9	1	79	4	Wandsworth.
8	—	11	1	13	1	16	1	20	1	13	1	163	17	Camberwell.
8	—	9	—	3	1	10	—	13	1	9	1	114	9	Greenwich.
—	—	4	—	4	—	3	—	8	—	8	—	62	1	Lewisham.
—	—	1	—	1	—	1	—	—	1	2	—	13	1	Woolwich.
1	—	6	—	3	2	6	1	3	1	1	—	43	7	Plumstead.
3	—	5	—	6	—	4	—	7	—	2	1	57	2	Lee.
—	—	4	—	4	—	—	—	—	—	—	—	13	—	Port of London.

§ Including Inner Temple (population, 96) ‖ Including Tower of London (population, 868)

Sanitary Areas.		Population (1891).	DIPHTHERIA—*continued.* Weekly Statement, 4th Quarter, 1900.													
			Oct. 6.		Oct. 13.		Oct. 20.		Oct. 27.		Nov. 3.		Nov. 10.		Nov. 17.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
London (*Administrative County.*)		4,232,118	278	29	264	26	294	35	307	39	266	41	299	35	286	32
W. District.	Kensington	166,308	4	2	8	1	7	1	8	—	10	—	11	2	9	1
	Fulham	91,639	23	3	30	2	25	3	37	2	24	5	21	1	28	—
	Hammersmith	97,239	2	1	8	2	12	—	2	1	11	1	4	—	9	—
	Paddington	117,846	3	—	3	—	5	—	11	—	2	—	6	1	2	—
	Chelsea	96,253	3	—	2	—	2	—	4	—	6	—	6	2	3	—
	St. George, Hanover Sq.*	78,599	—	1	—	—	—	—	4	1	3	—	3	—	3	1
	Westminster	55,539	3	—	1	—	4	—	1	—	2	—	1	—	6	—
	St. James, Westminster	24,995	—	—	—	—	3	—	—	—	—	—	—	—	—	—
N. District.	St. Marylebone	142,404	9	1	2	—	2	1	10	2	3	1	13	—	6	1
	Hampstead	68,416	5	—	9	2	12	2	6	2	4	1	6	—	4	1
	St. Pancras	234,379	15	1	11	1	19	—	16	1	13	—	17	4	17	1
	Islington	319,143	19	2	10	2	16	2	22	3	17	5	11	4	19	2
	St. Mary, Stoke Newington	30,936	3	—	9	—	11	—	4	3	4	—	2	1	7	2
	Hackney	198,606	16	1	18	—	19	1	14	3	23	2	16	1	8	—
Central District.	St. Giles and St. George, Bloomsbury.	39,782	2	—	1	—	1	—	1	—	5	—	2	1	1	2
	St. Martin-in-the-Fields	14,616	—	—	—	—	1	—	—	—	—	—	—	—	—	—
	Strand†	25,217	1	—	2	—	2	—	1	—	—	—	—	—	2	—
	Holborn‡	34,043	3	—	2	—	—	—	1	—	—	—	4	—	1	—
	Clerkenwell	66,216	6	—	3	—	—	—	1	—	4	—	3	—	1	—
	St. Luke, Middlesex	42,440	1	—	2	—	2	—	1	1	2	—	1	—	1	—
	London, City of§	37,583	1	—	2	—	—	—	3	—	1	1	—	—	2	—
E. District.	Shoreditch	124,009	3	3	5	—	2	—	12	1	8	2	5	1	3	—
	Bethnal Green	129,132	8	—	10	—	12	2	5	3	5	2	5	1	6	—
	Whitechapel‖	74,420	4	1	4	1	7	—	6	—	3	—	2	—	3	—
	St. George-in-the-East	45,795	3	—	5	—	—	—	3	—	1	—	—	—	2	2
	Limehouse	57,376	5	—	2	1	2	1	7	1	—	—	6	—	4	1
	Mile End Old Town	107,592	13	2	9	2	7	2	8	3	8	—	6	—	11	2
	Poplar	166,748	27	3	20	3	22	2	11	1	15	4	31	3	29	3
S. District.	St. Saviour, Southwark	27,177	—	—	—	—	1	—	—	—	—	—	1	—	1	—
	St. George, Southwark	59,712	5	—	2	—	2	—	1	—	3	—	6	1	5	1
	Newington	115,804	4	—	13	2	12	2	5	1	11	1	15	—	12	3
	St. Olave, Southwark	12,723	—	—	1	—	—	—	—	—	1	—	—	—	—	—
	Bermondsey	84,682	10	2	9	2	10	1	4	1	7	1	7	1	4	—
	Rotherhithe	39,255	2	—	—	—	3	—	1	—	2	—	4	2	1	—
	Lambeth	275,203	12	1	6	—	11	1	17	1	8	1	16	1	17	1
	Battersea	150,558	8	1	5	2	10	1	7	1	6	1	6	—	6	—
	Wandsworth	156,942	10	—	6	1	8	3	10	—	3	1	9	1	17	2
	Camberwell	235,344	17	1	17	—	18	5	33	5	24	9	22	1	15	4
	Greenwich	165,413	11	2	13	1	11	2	14	1	9	—	16	1	6	1
	Lewisham	92,647	5	1	4	—	3	2	7	—	5	1	6	2	11	1
	Woolwich	40,848	3	—	2	—	1	—	1	—	5	—	1	2	2	—
	Plumstead	52,436	5	—	4	1	5	—	4	—	5	—	6	1	2	—
	Lee	36,103	4	—	4	—	4	1	3	1	2	2	2	—	—	—
	Port of London	—	—	—	—	—	—	—	1	—	1	—	—	—	—	—

* Including St. Peter's, Westminster (population, 235). † Including Middle Temple (population, 95).
‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).

DIPHTHERIA—*continued.*

Weekly Statement, 4th Quarter, 1900—*continued.* Nov. 24. Cases.	Nov. 24. Deaths.	Dec. 1. Cases.	Dec. 1. Deaths.	Dec. 8. Cases.	Dec. 8. Deaths.	Dec. 15. Cases.	Dec. 15. Deaths.	Dec. 22. Cases.	Dec. 22. Deaths.	Dec. 29. Cases.	Dec. 29. Deaths.	Totals for 4th Quarter, 1900. Cases.	Totals for 4th Quarter, 1900. Deaths.	Grand Totals for Year, 1900. Cases.	Grand Totals for Year, 1900. Deaths.	Sanitary Areas.
222	22	239	29	228	34	235	20	205	35	196	25	3,319	402	11,780	1,539	London. (*Administrative County.*)
3	1	14	—	3	—	10	1	5	2	7	—	99	11	329	27	Kensington.
9	—	12	1	10	1	18	1	10	—	5	1	252	20	635	66	Fulham.
6	—	9	1	3	—	10	—	3	—	8	—	87	6	252	28	Hammersmith.
1	—	3	—	2	2	2	—	5	2	4	2	49	7	152	27	Paddington.
13	1	2	—	4	—	1	—	1	—	2	—	49	3	179	18	Chelsea.
5	—	—	—	—	—	2	—	4	1	2	—	26	4	89	11	St. George, Hanover Sq.*
3	—	1	—	3	—	4	—	1	—	4	—	34	—	104	8	Westminster.
—	—	—	—	—	—	1	—	2	—	—	—	6	—	39	4	St. James, Westminster.
2	1	3	1	4	—	1	1	2	1	2	—	59	10	214	40	St. Marylebone.
5	1	6	1	4	—	2	1	3	1	4	—	70	12	156	31	Hampstead.
12	—	8	1	18	2	8	1	9	3	5	—	168	15	584	72	St. Pancras.
18	3	14	1	18	3	16	2	18	3	14	—	212	32	628	105	Islington.
5	1	4	—	5	1	11	—	5	2	6	1	76	11	127	14	St. Mary, Stoke Newington.
12	—	13	1	13	1	13	1	13	—	5	2	183	13	614	59	Hackney.
1	—	1	—	2	—	—	—	—	—	1	—	18	3	58	8	St. Giles and St. George, Bloomsbury.
—	—	—	—	—	—	—	—	1	—	—	—	2	—	14	2	St. Martin-in-the-Fields.
—	—	1	—	1	—	—	—	—	—	—	—	10	—	37	3	Strand.†
1	—	2	—	—	—	1	—	1	—	—	—	16	—	67	5	Holborn.‡
—	—	—	—	1	—	2	—	1	1	1	—	23	1	118	18	Clerkenwell.
1	—	2	—	1	—	3	—	3	1	1	—	21	2	74	13	St. Luke, Middlesex.
—	—	2	—	—	—	—	—	—	—	1	—	12	1	66	6	London, City of.§
5	2	8	2	13	2	8	1	16	—	10	2	98	16	344	57	Shoreditch.
4	—	5	—	5	1	7	—	7	—	5	1	84	10	391	63	Bethnal Green.
3	—	1	—	5	—	5	—	5	1	5	1	53	4	256	19	Whitechapel.‖
—	—	2	1	—	—	—	—	1	—	2	1	19	4	114	14	St. George-in-the-East.
5	—	5	2	3	—	6	—	1	—	1	—	47	6	180	17	Limehouse.
2	—	1	2	5	1	2	—	4	1	6	1	82	16	289	35	Mile End Old Town.
32	2	17	4	21	8	19	3	14	6	12	3	270	45	620	115	Poplar.
—	—	1	—	3	2	4	—	4	—	3	1	18	3	115	15	St. Saviour, Southwark
3	1	1	1	5	—	1	—	6	—	8	—	48	4	216	23	St. George, Southwark.
6	2	6	—	6	1	8	—	5	2	7	1	110	15	437	70	Newington.
—	—	—	—	—	—	—	—	—	—	2	1	4	1	14	3	St. Olave, Southwark.
5	3	8	1	5	1	8	—	7	1	4	1	88	15	347	59	Bermondsey.
—	—	2	—	4	3	1	1	—	—	1	1	21	7	107	26	Rotherhithe.
9	—	17	1	8	3	15	1	8	—	9	1	153	12	841	101	Lambeth.
3	1	4	1	11	—	9	2	4	1	5	—	84	11	309	34	Battersea.
8	—	10	3	8	—	6	—	3	1	11	—	109	12	448	44	Wandsworth.
18	3	27	3	20	2	16	4	15	2	12	1	254	40	891	132	Camberwell.
6	—	12	1	5	—	4	—	14	2	9	3	130	14	503	64	Greenwich.
8	—	6	—	2	—	3	—	3	—	5	—	68	7	307	32	Lewisham.
—	—	4	—	5	—	4	—	—	—	3	—	31	2	98	7	Woolwich.
5	—	4	—	2	—	1	—	1	1	3	—	47	3	237	25	Plumstead.
3	—	1	—	—	—	3	—	—	—	—	—	26	4	163	19	Lee.
—	—	—	—	—	—	—	—	—	—	1	—	3	—	17	—	Port of London.

§ Including Inner Temple (population, 96).

‖ Including Tower of London (population, 868).

	Sanitary Areas.	Population (1891).	Enteric Fever. Weekly Statement, 1st Quarter, 1900. Jan. 6. Cases.	Jan. 6. Deaths.	Jan. 13. Cases.	Jan. 13. Deaths.	Jan. 20. Cases.	Jan. 20. Deaths.	Jan. 27. Cases.	Jan. 27. Deaths.	Feb. 3. Cases.	Feb. 3. Deaths.	Feb. 10. Cases.	Feb. 10. Deaths.	Feb. 17. Cases.	Feb. 17. Deaths.
	London .. .. . . (*Administrative County.*)	4,232,118	95	18	89	23	93	17	103	13	84	15	69	21	77	18
W. District.	Kensington	166,308	2	1	1	1	3	1	3	1	3	1	—	—	1	—
	Fulham	91,639	1	—	1	—	3	3	6	1	2	1	2	1	2	1
	Hammersmith	97,239	3	—	1	—	1	—	3	1	3	—	—	—	—	—
	Paddington	117,846	2	1	—	—	2	—	1	—	—	—	1	—	1	—
	Chelsea..	96,253	—	—	—	—	3	—	—	—	1	1	1	—	—	—
	St. George, Hanover Sq.* ..	78,599	1	—	—	—	1	—	2	—	1	—	—	—	2	1
	Westminster	55,539	1	1	—	1	1	—	1	—	—	—	—	—	—	—
	St. James, Westminster ..	24,905	—	—	—	—	—	—	—	—	—	—	—	—	—	—
N. District.	St. Marylebone	142,404	1	—	2	—	2	1	4	—	2	—	—	—	—	—
	Hampstead	68,416	—	1	—	—	—	—	—	—	—	—	1	—	—	—
	St. Pancras	234,379	4	2	8	4	4	2	9	2	7	1	5	—	8	1
	Islington	319,143	8	2	6	3	3	2	4	2	4	—	3	—	4	—
	St. Mary, Stoke Newington	30,936	—	—	—	2	—	—	1	—	—	—	—	—	—	1
	Hackney	198,606	7	2	4	1	7	—	8	—	3	3	2	1	6	2
Central District.	St. Giles and St. George, Bloomsbury.	39,782	—	—	3	—	1	—	1	—	—	—	1	—	—	—
	St. Martin-in-the-Fields ..	14,616	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Strand †	25,217	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Holborn ‡	34,043	2	—	—	—	3	—	1	—	1	1	—	1	—	—
	Clerkenwell	66,216	4	—	—	1	—	—	1	—	—	—	—	—	1	—
	St. Luke, Middlesex ..	42,440	—	—	1	—	—	—	—	—	1	—	1	—	2	1
	London, City of §	37,583	—	—	1	—	—	—	4	—	—	—	—	—	2	—
E. District.	Shoreditch	124,009	1	1	3	—	1	—	4	—	3	—	6	1	2	—
	Bethnal Green	129,132	5	2	5	—	6	—	7	1	5	—	4	1	4	1
	Whitechapel ‖	74,420	2	—	4	1	3	—	2	—	2	—	1	—	2	1
	St. George-in-the-East ..	45,795	3	—	1	—	3		2	—	2	—	1	1	3	—
	Limehouse	57,376	3		2	1	1	—	2	—	1	—	—	—	3	—
	Mile End Old Town ..	107,592	3	1	3	1	3	2	1	—	1	—	3	1	2	—
	Poplar	166,748	6	—	8	—	3	1	6	—	10	1	9	5	6	3
S. District.	St. Saviour, Southwark ..	27,177	—	—	2	—	1	1	—	—	1	1	—		—	—
	St. George, Southwark ..	59,712	1	—	—	—	1	—	1	—	—	—	—	—	2	—
	Newington	115,804	2	—	5	—	4	—	1	—	3	—	2	—	—	1
	St. Olave, Southwark ..	12,723	—	—	—	—	—	—	1	—	—	—	—	—	—	—
	Bermondsey	84,682	1	—	2	—	3	—	—	1	—	—	1	—	—	—
	Rotherhithe	39,255	2	—	2	1	4	—	—	—	5	—	—	1	1	—
	Lambeth	275,203	1	—	4	2	6	—	3	1	7	—	9	3	4	3
	Battersea	150,558	8	1	4	—	3	—	8	1	8	1	6	2	5	—
	Wandsworth	156,942	1	2	2	1	3	2	7	—	1	3	1	—	5	1
	Camberwell	235,344	7	1	7	1	3	—	4	—	2	—	6	2	2	—
	Greenwich	165,413	5	—	6	—	7	2	4	2	4	1	2	1	5	—
	Lewisham	92,647	5	—	—	1	1	—	1	—	1	—	—	—	1	1
	Woolwich	40,848	—	—	—	1	—	—	—	—	—	—	—	—	—	—
	Plumstead	52,436	—	—	—	—	—	—	—	—	—	—	—	—	1	—
	Lee	36,103	—	—	—	—	1	—	—	—	—	—	1	—	—	—
	Port of London	—	3	—	1	—	2	—	—	—	—	—	—	—	—	—

* Including St. Peter's, Westminster (population, 235). † Including Middle Temple (population, 95).
‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).

ENTERIC FEVER—*continued.*

Weekly Statement, 1st Quarter, 1900—*continued.*												Totals for 1st Quarter, 1900.		Sanitary Areas.
Feb. 24.		Mar. 3.		Mar. 10.		Mar. 17.		Mar. 24.		Mar. 31.				
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
78	16	86	16	62	11	66	13	61	7	62	6	1,025	194	London. (*Administrative County.*)
1	—	3	—	—	—	—	—	3	—	—	—	20	5	Kensington.
1	—	2	2	5	—	1	—	1	—	4	—	31	9	Fulham.
—	—	2	—	—	—	1	1	5	—	1	—	20	2	Hammersmith.
1	—	—	—	—	—	—	—	1	—	—	—	9	1	Paddington.
—	—	—	—	1	—	—	—	—	—	—	—	6	1	Chelsea.
—	—	3	1	1	—	—	1	—	—	2	—	13	3	St. George, Hanover Sq.*
—	—	—	—	—	—	—	—	—	—	—	—	3	2	Westminster.
—	—	—	—	1	—	—	—	—	—	—	—	1	—	St. James, Westminster.
4	—	2	—	2	1	1	1	2	—	1	—	23	3	St. Marylebone.
1	—	2	—	—	—	1	—	—	—	3	—	8	1	Hampstead.
2	1	7	2	6	1	4	—	2	1	3	1	69	18	St. Pancras.
2	—	3	—	4	—	1	—	2	—	5		49	9	Islington.
—	—	—	—	—	—	1	—	—	—	1	—	3	3	St. Mary, Stoke Newington.
3	2	11	1	2	—	3	2	8	—	4	1	68	15	Hackney.
1	—	1	—	—	1	—	—	—	—	—	—	8	1	St. Giles and St. George Bloomsbury.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Martin-in-the-Fields.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Strand.†
—	—	—	—	—	—	2	—	—	—	—	—	9	2	Holborn.‡
2	—	—	1	1	—	—	—	1	—	1	—	11	2	Clerkenwell.
1	—	1	—	—	—	2	—	—	—	—	—	9	1	St. Luke, Middlesex.
—	—	—	—	—	—	—	—	—	—	3	—	10	—	London, City of.§
1	1	3	—	3	—	1	—	1	—	—	—	29	3	Shoreditch.
1	—	2	—	1	—	—	—	—	1	4	—	44	6	Bethnal Green.
2	1	—	—	1	—	1	—	4	—	1	—	25	3	Whitechapel.‖
1	1	1	—	1	—	1	—	2	1	—	—	21	3	St. George-in-the-East.
1	—	3	—	2	—	1	1	1	—	—	—	20	2	Limehouse.
5	1	3	2	—	1	4	—	—	—	1	—	29	9	Mile End Old Town.
4	2	4	2	6	—	3	—	5	—	3	1	73	15	Poplar.
—	—	—	1	—	—	—	—	—	—	—	—	4	3	St. Saviour, Southwark.
1	—	1	—	3	1	3	1	1	—	—	—	14	2	St. George, Southwark.
2	—	2	—	—	—	2	—	3	—	2	—	28	1	Newington.
—	—	—	—	—	—	—	—	1	—	—	—	2	—	St. Olave, Southwark.
3	2	1	—	1	1	—	1	—	—	5	—	17	5	Bermondsey.
3	—	2	—	1	—	5	—	1	—	—	—	26	2	Rotherhithe.
6	—	7	1	4	1	6	1	3	1	2	—	62	13	Lambeth.
4	2	7	1	6	3	11	—	5	2	3	2	78	15	Battersea.
4	—	3	—	5	—	3	2	2	1	5	—	42	12	Wandsworth.
5	2	4	—	1	—	3	—	1	—	2	—	47	6	Camberwell.
12	1	1	1	1	1	3	—	3	—	2	—	55	9	Greenwich.
1	—	2	—	2	—	1	—	2	—	2	1	19	3	Lewisham.
—	—	—	—	—	—	—	—	—	—	—	—	—	1	Woolwich.
1	—	1	1	—	—	1	1	—	—	2	—	6	2	Plumstead.
1	—	1	—	1	—	—	1	1	—	—	—	6	1	Lee.
1	—	1	—	—	—	—	—	—	—	—	—	8	—	Port of London.

§ Including Inner Temple (population, 16) ‖ Including Tower of London (population, 868).

	Sanitary Areas.	Population (1891).	ENTERIC FEVER—*continued.* Weekly Statement, 2nd Quarter, 1900. Apr. 7. Cases.	Apr. 7. Deaths.	Apr. 14. Cases.	Apr. 14. Deaths.	Apr. 21. Cases.	Apr. 21. Deaths.	Apr 28. Cases.	Apr 28. Deaths.	May 5. Cases.	May 5. Deaths.	May 12. Cases.	May 12. Deaths.	May 19. Cases.	May 19. Deaths.
	London (*Administrative County.*)	4,232,118	55	18	44	12	60	8	50	7	34	6	54	3	48	11
W. District.	Kensington	166,308	3	—	—	—	—	—	1	—	—	—	4	—	—	—
	Fulham	91,639	2	2	2	—	1	1	1	—	1	—	1	—	—	—
	Hammersmith	97,239	—	—	2	—	1	—	3	—	1	1	1	1	2	—
	Paddington	117,846	1	—	—	—	2	—	1	—	2	—	1	—	—	—
	Chelsea	96,253	4	1	—	2	—	—	—	—	1	—	—	—	—	—
	St. George, Hanover Sq.*	78,599	1	—	1	—	2	1	2	—	4	—	—	1	1	—
	Westminster	55,539	—	—	—	—	2	—	—	—	1	—	—	—	2	—
	St. James, Westminster	24,995	—	—	—	—	—	—	—	—	—	—	—	—	—	—
N. District.	St. Marylebone	142,404	1	—	1	—	1	—	1	—	—	—	1	—	1	—
	Hampstead	68,416	1	1	—	1	2	—	—	—	—	—	—	—	—	—
	St. Pancras	234,379	8	3	1	—	3	1	8	1	—	—	4	—	7	1
	Islington	319,143	1	2	2	1	5	—	1	3	1	—	4	—	6	2
	St. Mary, Stoke Newington	30,936	1	—	—	—	1	—	1	—	—	—	—	—	—	—
	Hackney	198,606	2	1	2	1	2	—	2	—	3	1	4	—	2	—
Central District.	St. Giles and St. George, Bloomsbury.	39,782	1	—	—	—	—	—	—	—	—	—	1	—	—	—
	St. Martin-in-the-Fields	14,616	—	—	1	—	—	—	—	—	—	—	—	—	—	—
	Strand†	25,217	—	—	—	—	—	—	—	—	—	—	—	—	1	—
	Holborn‡	34,043	—	—	—	—	—	—	—	—	—	—	1	—	—	—
	Clerkenwell	66,216	—	—	2	—	1	—	—	—	1	—	—	—	—	—
	St. Luke, Middlesex	42,440	—	—	1	—	—	—	1	—	1	—	1	—	1	—
	London, City of §	37,583	1	—	—	—	1	—	—	—	—	—	1	—	—	—
E. District.	Shoreditch	124,009	—	—	2	—	1	1	1	—	—	—	—	—	1	—
	Bethnal Green	129,132	1	—	—	—	—	—	3	—	2	—	1	—	1	—
	Whitechapel‖	74,420	3	—	—	—	3	—	3	—	—	—	—	—	—	—
	St. George-in-the-East	45,795	2	1	—	—	—	—	1	—	2	1	—	—	—	—
	Limehouse	57,376	1	—	1	—	1	—	—	—	—	—	1	—	—	—
	Mile End Old Town	107,592	1	—	2	—	1	—	1	—	—	—	—	—	—	—
	Poplar	166,748	2	1	2	—	3	—	3	—	3	—	2	—	5	2
S. District.	St. Saviour, Southwark	27,177	1	—	1	—	—	—	—	—	—	—	—	—	—	—
	St. George, Southwark	59,712	—	—	—	—	—	—	1	—	—	—	1	—	2	—
	Newington	115,804	1	1	2	—	—	—	2	1	—	—	2	—	2	2
	St. Olave, Southwark	12,723	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Bermondsey	84,682	3	1	2	1	1	—	2	1	1	1	5	—	—	2
	Rotherhithe	39,255	3	—	—	1	1	—	—	—	—	—	2	—	1	—
	Lambeth	275,203	1	2	3	2	8	2	5	1	1	—	6	—	2	2
	Battersea	150,558	2	—	6	—	3	1	1	—	1	—	1	1	4	2
	Wandsworth	156,942	2	—	4	—	1	—	1	—	—	—	2	—	2	—
	Camberwell	235,344	2	1	2	1	5	—	1	—	1	1	1	—	1	—
	Greenwich	165,413	2	1	1	1	4	—	1	—	1	—	2	—	3	1
	Lewisham	92,647	—	—	—	—	2	—	1	—	1	1	2	—	—	—
	Woolwich	40,848	—	—	—	1	—	—	—	—	—	—	1	—	—	—
	Plumstead	52,436	1	—	—	—	2	1	—	—	—	—	1	—	—	—
	Lee	36,103	—	—	1	—	—	—	—	—	4	—	—	—	1	—
	Port of London	—	—	—	—	—	—	—	1	—	1	—	—	—	—	—

* Including St. Peter's, Westminster (population, 235). † Including Middle Temple (population, 95).
‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 1[illegible]), Staple Inn (population, 21), and Furnival's Inn (population, 121).

Enteric Fever—*continued.* Weekly Statement, 2nd Quarter, 1900—*continued.* May 26.		June 2.		June 9.		June 16.		June 23.		June 30.		Totals for 2nd Quarter, 1900.		Sanitary Areas.
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths	Cases.	Deaths.	Cases.	Deaths.	
50	[illegible]	53	9	48	7	66	8	40	4	49	11	651	113	London. (*Administrative County.*)
3	—	—	1	2	—	2	—	2	—	1	—	18	1	Kensington.
1	—	1	1	1	—	2	—	1	1	—	—	14	5	Fulham.
1	—	2	—	1	—	1	—	1	—	3	1	19	3	Hammersmith.
1	—	1	—	1	—	1	—	1	—	—	—	12	—	Paddington.
—	—	1	—	1	—	—	—	—	—	—	1	7	4	Chelsea.
—	—	1	—	1	—	1	—	1	—	1	—	16	2	St. George, Hanover Sq.*
2	—	2	1	—	1	—	—	1	—	—	1	10	3	Westminster.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. James, Westminster.
—	—	2	—	1	—	1	—	—	—	1	—	11	—	St. Marylebone.
1	—	—	—	1	—	1	—	1	—	—	—	7	2	Hampstead.
5	—	4	—	4	1	11	2	2	1	7	—	64	10	St. Pancras.
5	—	5	1	2	—	3	—	4	—	7	2	46	11	Islington.
—	—	1	—	1	1	2	—	—	—	1	—	8	1	St. Mary, Stoke Newington.
3	1	2	—	4	—	2	—	4	—	3	—	35	4	Hackney.
1	—	—	—	—	—	1	—	1	—	2	1	7	1	St. Giles and St. George Bloomsbury.
1	1	—	—	—	—	1	—	—	—	—	—	3	1	St. Martin-in-the-Fields.
—	—	—	—	—	—	1	—	—	1	—	—	2	1	Strand.†
—	—	1	—	2	1	—	—	—	—	—	—	4	1	Holborn.‡
1	—	—	—	2	—	1	—	2	—	—	—	10	—	Clerkenwell.
—	—	—	—	—	—	2	—	—	—	—	—	7	—	St. Luke, Middlesex.
—	—	—	—	—	—	—	—	—	—	—	—	3	—	London, City of.§
1	—	4	—	3	—	3	1	1	—	2	—	19	2	Shoreditch.
2	—	1	—	2	—	2	1	2	—	2	—	19	1	Bethnal Green.
—	—	—	—	1	—	2	1	—	—	—	—	12	1	Whitechapel.‖
—	—	1	—	1	—	1	—	—	—	1	—	9	2	St. George-in-the-East.
—	—	—	—	2	—	—	—	—	—	—	—	6	—	Limehouse.
—	—	2	—	—	—	2	—	1	—	—	—	10	—	Mile End Old Town.
7	2	4	—	—	—	5	—	2	—	—	—	38	5	Poplar.
—	—	—	—	1	—	—	—	—	—	—	—	3	—	St. Saviour, Southwark.
1	—	—	—	—	—	—	—	—	—	—	—	5	—	St. George, Southwark.
—	—	—	—	1	—	1	—	—	—	3	1	14	5	Newington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Olave, Southwark.
1	—	3	2	2	1	1	1	—	—	—	1	21	11	Bermondsey.
1	—	1	—	2	—	—	—	—	—	1	—	12	1	Rotherhithe.
2	—	2	1	1	—	—	—	3	—	6	2	40	12	Lambeth.
—	—	4	1	—	1	5	—	—	—	1	—	28	6	Battersea.
4	1	3	—	2	1	3	1	3	—	3	—	30	3	Wandsworth
1	1	1	—	5	—	1	1	1	—	1	1	23	6	Camberwell
3	—	2	—	—	—	4	—	1	—	1	—	25	3	Greenwich.
—	—	1	—	1	—	3	—	—	—	1	—	12	1	Lewisham.
—	—	—	—	—	—	—	—	1	—	—	—	2	1	Woolwich.
—	—	1	—	—	—	—	—	—	—	—	—	5	1	Plumstead.
—	—	—	1	—	—	—	—	2	1	1	—	9	2	Lee.
2	—	—	—	—	—	—	—	2	—	—	—	6	—	Port of London.

§ Including Inner Temple (population, 96). ‖ Including Tower of London (population, 885).

	Sanitary Areas.	Population (1891).	ENTERIC FEVER—*continued.* Weekly Statement, 3rd Quarter, 1900. July 7. Cases.	July 7. Deaths.	July 14. Cases.	July 14. Deaths.	July 21. Cases.	July 21. Deaths.	July 28. Cases.	July 28. Deaths.	Aug. 4. Cases.	Aug. 4. Deaths.	Aug. 11. Cases.	Aug. 11. Deaths.	Aug. 18. Cases.	Aug. 18. Deaths.
	London .. .. (*Administrative County.*)	4,232,118	38	7	43	13	38	9	47	12	53	7	57	6	52	6
W. District.	Kensington	166,308	—	—	1	1	3	—	2	1	1	—	1	—	1	1
	Fulham	91,639	1	—	—	—	1	—	1	—	2	—	—	—	2	1
	Hammersmith	97,239	1	—	—	—	2	1	2	—	1	—	2	—	2	—
	Paddington	117,846	—	—	1	—	2	—	—	—	—	—	1	—	—	—
	Chelsea	96,253	—	—	1	—	1	—	1	1	—	—	—	—	—	—
	St. George, Hanover Sq.* ..	78,599	—	—	1	—	—	—	—	—	1	—	—	—	—	—
	Westminster	55,539	1	—	1	1	—	—	—	—	—	—	—	—	1	—
	St. James, Westminster ..	24,995	—	—	1	—	—	—	—	—	—	—	—	—	—	—
N. District.	St. Marylebone	142,404	—	—	1	1	—	—	1	1	2	—	1	—	1	—
	Hampstead	68,416	1	—	2	—	—	—	2	—	2	—	1	—	—	—
	St. Pancras	234,379	6	2	4	1	1	—	5	—	6	1	4	2	2	2
	Islington	319,143	3	—	6	1	3	1	2	—	5	2	5	—	4	1
	St. Mary, Stoke Newington	30,936	—	—	—	—	—	1	—	—	1	—	1	—	—	—
	Hackney	198,606	1	1	2	—	1	1	2	—	3	1	1	—	6	—
Central District.	St. Giles and St. George, Bloomsbury.	39,782	—	—	—	1	2	1	—	1	—	—	—	—	1	—
	St. Martin-in-the-Fields ..	14,616	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Strand†	25,217	—	—	1	—	—	—	—	1	—	—	—	—	1	—
	Holborn‡	34,043	1	—	—	—	1	—	—	—	1	—	1	—	—	—
	Clerkenwell	66,216	—	1	—	—	—	—	1	—	—	—	1	—	—	—
	St. Luke, Middlesex ..	42,440	—	—	—	—	—	—	1	1	—	—	—	—	1	—
	London, City of §	37,583	—	—	—	—	—	—	1	—	—	—	—	—	—	—
E. District.	Shoreditch	124,009	2	—	1	—	1	—	2	—	4	—	3	—	2	—
	Bethnal Green	129,132	—	—	—	—	—	—	3	—	5	—	1	—	3	—
	Whitechapel‖	74,420	—	1	1	—	2	—	3	1	—	—	2	—	—	—
	St. George-in-the-East ..	45,795	2	—	1	—	—	—	—	—	1	—	1	—	1	—
	Limehouse	57,376	—	—	—	—	2	—	1	—	—	—	—	—	—	—
	Mile End Old Town ..	107,592	2	—	1	1	3	—	2	—	—	—	3	2	3	—
	Poplar	166,748	4	—	4	1	2	—	1	3	5	2	16	—	2	—
S. District.	St. Saviour, Southwark ..	27,177	—	—	—	—	—	—	1	—	—	—	—	—	—	—
	St. George, Southwark ..	59,712	—	—	1	—	—	—	—	—	2	—	—	—	—	—
	Newington	115,804	—	—	—	—	—	—	3	—	—	1	3	—	3	—
	St. Olave, Southwark ..	12,723	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Bermondsey	84,682	—	—	1	1	—	1	—	—	2	—	—	—	1	—
	Rotherhithe	39,255	—	—	—	—	2	—	2	—	1	—	—	—	1	—
	Lambeth	275,203	4	—	1	2	2	1	2	—	—	—	2	—	1	—
	Battersea	150,558	1	—	3	—	2	1	—	1	3	—	1	1	4	—
	Wandsworth	156,942	3	—	3	—	1	1	1	—	1	—	2	—	3	—
	Camberwell	235,344	3	1	1	2	2	—	1	—	1	—	2	—	1	—
	Greenwich	165,413	1	—	1	—	—	—	2	1	3	—	—	1	3	1
	Lewisham	92,647	1	—	1	—	—	—	—	—	—	—	—	—	—	—
	Woolwich	40,848	—	—	—	—	—	—	2	—	—	—	—	—	—	—
	Plumstead	52,436	—	1	—	—	—	—	—	—	—	—	1	—	1	—
	Lee	36,103	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Port of London	—	—	—	1	—	2	—	—	—	—	—	1	—	1	—

* Including St. Peter's, Westminster (population, 235). † Including Middle Temple (population, 95).
‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136) Staple Inn (population, 21), and Furnival's Inn (population, 121)

ENTERIC FEVER—*continued.*

Weekly Statement, 3rd Quarter, 1900—*continued.*											Totals for 3rd Quarter, 1900.		Sanitary Areas.
...t. 25.	Sept. 1.		Sept. 8.		Sept. 15.		Sept. 22.		Sept. 29.				
Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
15	64	7	74	15	128	22	142	11	149	16	959	146	London. (*Administrative County.*)
—	1	—	1	—	3	1	4	—	3	1	22	5	Kensington.
—	2	—	1	—	5	1	5	—	4	—	26	2	Fulham.
—	1	—	1	—	2	—	2	—	—	—	17	1	Hammersmith.
—	2	1	—	—	4	—	—	—	1	—	13	1	Paddington.
1	2	1	5	1	6	1	5	—	6	2	27	7	Chelsea.
1	—	1	—	—	2	—	2	—	1	—	8	2	St. George, Hanover Sq.*
—	—	—	—	—	2	—	—	—	1	1	6	2	Westminster.
—	—	—	—	—	—	—	—	—	—	—	1	—	St. James, Westminster.
—	—	—	1	1	—	—	2	—	—	—	9	3	St. Marylebone.
—	1	—	—	—	2	—	—	—	1	—	12	—	Hampstead.
1	5	1	8	2	4	1	4	—	3	1	55	14	St. Pancras.
2	7	1	3	—	12	1	9	—	7	2	68	11	Islington.
—	3	—	—	—	1	—	—	—	1	—	7	1	St. Mary, Stoke Newington
—	3	—	5	4	9	—	8	1	1	—	45	8	Hackney.
—	—	—	—	—	—	—	1	—	—	—	4	3	St. Giles and St. George, Bloomsbury.
—	—	—	1	—	—	—	—	—	—	—	1	—	St. Martin-in-the-Fields.
—	—	—	—	—	—	—	2	—	—	—	4	1	Strand.†
—	—	—	1	—	—	—	—	—	—	—	6	—	Holborn.‡
1	—	—	—	—	—	—	3	—	2	—	8	2	Clerkenwell.
1	—	—	—	—	—	—	—	—	1	—	5	2	St. Luke, Middlesex.
—	—	—	1	—	1	—	—	1	—	—	6	1	London, City of.§
—	3	—	1	1	1	—	1	—	3	—	24	1	Shoreditch.
1	1	—	1	—	6	1	1	—	5	—	30	2	Bethnal Green.
—	1	—	1	—	—	—	2	—	—	—	12	2	Whitechapel.‖
1	—	—	4	—	5	1	—	1	3	—	20	3	St. George-in-the-East.
—	1	—	3	—	2	1	1	—	3	—	16	1	Limehouse.
1	2	—	2	—	6	1	1	—	5	—	34	5	Mile End Old Town.
3	4	—	2	2	7	1	7	1	3	3	67	16	Poplar.
—	—	—	—	—	—	—	4	—	1	—	6	—	St. Saviour, Southwark.
—	—	—	2	—	1	—	27	—	49	—	83	—	St. George, Southwark.
—	3	—	—	—	1	1	6	—	4	2	23	4	Newington.
—	1	—	—	—	—	—	1	—	—	—	2	—	St. Olave, Southwark.
—	5	—	4	1	7	4	5	1	3	—	33	8	Bermondsey.
1	—	—	—	—	4	—	6	1	3	1	19	3	Rotherhithe.
—	4	2	3	—	11	1	16	3	19	1	69	10	Lambeth.
1	3	—	3	—	4	—	3	1	6	—	41	5	Battersea.
—	1	—	3	—	6	—	7	1	4	1	37	3	Wandsworth.
—	3	—	6	1	2	2	1	—	3	1	30	7	Camberwell.
—	3	—	9	—	7	1	3	—	1	—	35	4	Greenwich.
—	1	—	1	1	3	3	1	—	—	—	10	4	Lewisham.
—	—	—	—	—	2	—	—	—	—	—	5	—	Woolwich.
—	—	—	—	1	—	—	1	—	—	—	3	2	Plumstead.
—	—	—	—	—	—	—	1	—	—	—	1	—	Lee.
—	1	—	1	—	—	—	—	—	2	—	9	—	Port of London.

* Including Inner Temple (population, 96).

‖ Including Tower of London (population, 868).

	Sanitary Areas.	Population (1891).	ENTERIC FEVER—*continued.* Weekly Statement, 4th Quarter, 1900. Oct. 6. Cases.	Oct. 6. Deaths.	Oct. 13. Cases.	Oct. 13. Deaths.	Oct. 20. Cases.	Oct. 20. Deaths.	Oct. 27. Cases.	Oct. 27. Deaths.	Nov. 3. Cases.	Nov. 3. Deaths.	Nov. 10. Cases.	Nov. 10. Deaths.	Nov. 17. Cases.	Nov. 17. Deaths.
	London .. .. (*Administrative County.*)	4,232,118	117	15	141	19	127	19	126	22	147	20	179	25	152	17
W. District.	Kensington	166,308	2	—	3	1	6	1	1	—	1	1	5	1	4	—
	Fulham	91,639	1	—	1	—	1	—	1	—	1	—	1	—	1	—
	Hammersmith	97,239	3	—	9	1	4	—	3	3	2	2	5	—	4	—
	Paddington	117,846	2	—	1	1	1	2	—	—	2	—	4	1	2	1
	Chelsea..	96,253	5	2	3	1	1	—	3	—	2	—	5	1	1	—
	St George, Hanover Sq.* ..	78,599	—	1	2	—	1	1	4	1	1	—	2	1	—	—
	Westminster	55,539	—	—	1	—	1	—	—	—	2	—	—	1	5	—
	St. James, Westminster ..	24,995	1	—	—	—	3	—	—	1	—	—	2	—	2	—
N. District.	St. Marylebone	142,404	1	—	4	2	3	—	1	2	2	—	4	—	2	—
	Hampstead	68,416	1	—	3	—	3	—	1	—	3	1	2	1	5	1
	St. Pancras	234,379	5	1	10	1	3	1	10	2	16	1	32	2	26	—
	Islington	319,143	7	—	8	—	9	1	5	1	7	1	8	2	11	3
	St. Mary, Stoke Newington	30,936	—	—	—	—	—	—	2	—	—	—	1	—	1	—
	Hackney	198,606	3	1	5	1	5	2	9	1	16	3	6	—	6	—
Central District.	St. Giles and St. George, Bloomsbury.	39,782	1	—	3	—	2	—	1	—	—	—	—	—	—	—
	St. Martin-in-the-Fields ..	14,616	—	—	—	—	—	—	2	—	1	—	—	1	1	—
	Strand†	25,217	—	1	—	—	—	—	1	—	—	—	—	—	—	—
	Holborn‡	34,043	—	—	1	—	—	—	1	1	—	—	1	—	1	—
	Clerkenwell	66,216	—	—	—	—	5	—	4	—	5	—	2	—	2	—
	St. Luke, Middlesex ..	42,440	—	—	—	—	—	—	—	1	1	—	2	2	1	—
	London, City of§	37,583	—	—	—	—	—	—	1	—	1	—	—	—	2	—
E. District.	Shoreditch	124,009	4	—	3	1	4	—	5	—	5	2	7	—	4	—
	Bethnal Green	129,132	2	—	4	—	5	—	3	1	9	—	10	—	5	2
	Whitechapel‖	74,420	—	—	2	—	4	—	1	—	5	—	8	—	—	1
	St. George-in-the-East ..	45,795	2	1	1	—	1	—	—	—	2	—	2	—	1	—
	Limehouse	57,376	2	—	1	1	5	—	5	—	4	—	3	—	2	—
	Mile End Old Town ..	107,592	3	1	2	1	5	1	5	1	2	1	7	2	2	—
	Poplar	166,748	9	—	8	1	5	1	9	1	8	1	10	1	6	—
S. District.	St. Saviour, Southwark ..	27,177	1	—	1	1	—	—	3	—	1	—	—	1	1	—
	St. George, Southwark ..	59,712	23	3	13	1	8	2	9	1	5	—	4	—	6	1
	Newington	115,804	2	—	6	—	3	2	2	1	1	2	6	1	4	1
	St. Olave, Southwark ..	12,723	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Bermondsey	84,682	5	—	4	1	6	—	1	—	7	—	6	—	5	—
	Rotherhithe	39,255	2	1	1	—	3	—	1	—	2	—	—	—	1	1
	Lambeth	275,203	9	1	10	2	11	1	11	2	8	2	7	2	8	1
	Battersea	150,558	4	1	6	—	4	2	2	—	5	—	4	—	5	—
	Wandsworth	156,942	2	1	4	—	2	—	2	—	1	—	2	—	6	—
	Camberwell	235,344	6	—	14	2	5	1	8	—	4	1	5	1	4	3
	Greenwich	165,413	7	—	3	—	4	—	5	—	5	1	6	1	7	1
	Lewisham	92,647	1	—	2	—	2	1	1	1	2	—	1	1	—	1
	Woolwich	40,848	—	—	1	—	—	—	1	—	6	—	2	1	4	—
	Plumstead	52,436	—	—	—	—	2	—	1	1	2	1	6	1	2	—
	Lee	36,103	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Port of London	—	1	—	1	—	—	—	1	—	—	—	1	—	2	—

* Including St. Peter's, Westminster (population, 235). † Including Middle Temple (population, 95).
‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).

ENTERIC FEVER—*continued.*

Weekly Statement, 4th Quarter, 1900—*continued.*												Totals for 4th Quarter, 1900.		Grand Totals for Year, 1900.		Sanitary Areas
Nov. 24.		Dec. 1.		Dec. 8.		Dec. 15.		Dec. 22.		Dec. 29.						
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
112	24	126	24	109	19	132	19	101	20	91	20	1,660	263	4,295	716	London. (*Administrative County.*)
2	—	4	—	7	1	2	—	—	1	6	—	43	6	103	17	Kensington.
2	—	4	1	—	—	4	—	1	—	3	1	21	2	92	18	Fulham.
2	—	5	1	1	—	3	1	2	1	4	2	47	11	103	17	Hammersmith.
2	—	1	—	2	—	2	—	2	—	1	1	22	6	56	8	Paddington.
6	—	2	1	4	1	—	—	3	—	6	1	41	7	81	19	Chelsea.
3	—	—	—	2	—	1	—	1	—	1	—	18	4	55	11	St. George, Hanover Sq.*
1	—	1	1	1	—	—	—	—	—	—	—	12	2	31	9	Westminster.
1	1	—	—	1	—	—	1	—	—	—	—	10	3	12	3	St. James, Westminster.
3	—	2	—	3	1	5	1	5	—	4	—	39	6	82	12	St. Marylebone.
1	1	3	—	—	—	1	1	—	1	—	—	23	6	56	9	Hampstead.
17	5	11	2	7	3	14	1	9	2	8	1	168	22	356	64	St. Pancras.
5	—	11	2	8	1	13	2	7	2	3	3	102	18	265	49	Islington.
1	1	1	—	—	—	—	—	—	—	—	—	6	1	24	6	St.Mary, Stoke Newington.
3	—	5	2	8	—	8	4	4	1	2	1	80	16	228	43	Hackney.
3	—	1	—	1	—	1	—	1	—	—	—	14	—	33	5	St. Giles and St. George Bloomsbury.
1	—	—	—	—	1	—	—	—	—	1	—	6	2	10	3	St. Martin-in-the-Fields.
1	—	—	—	1	1	1	—	—	—	—	—	4	2	10	4	Strand.†
—	—	1	—	—	—	—	—	—	—	1	—	6	1	25	4	Holborn.‡
2	—	4	—	2	—	3	—	1	1	1	1	31	2	60	6	Clerkenwell.
4	—	1	—	2	—	—	—	—	—	—	—	11	3	32	6	St. Luke, Middlesex.
1	—	—	—	—	1	4	—	—	—	1	—	10	1	29	2	London, City of.§
4	—	4	2	2	—	5	2	3	1	2	—	52	8	124	14	Shoreditch.
3	2	6	—	5	1	2	1	3	—	3	2	60	9	153	18	Bethnal Green.
2	1	3	1	2	—	1	—	1	—	1	—	30	3	79	9	Whitechapel.‖
—	1	2	—	2	—	1	—	—	—	1	—	15	2	65	10	St. George-in-the-East.
2	1	4	2	1	—	1	—	2	—	1	—	33	4	75	7	Limehouse.
5	—	—	—	4	—	3	—	5	1	3	—	46	8	119	22	Mile End Old Town.
7	1	6	—	6	2	9	1	4	2	4	—	91	11	269	47	Poplar.
1	—	5	—	1	—	—	1	—	—	—	—	14	3	27	6	St. Saviour, Southwark.
—	1	4	1	—	—	—	—	3	—	2	—	77	10	179	12	St. George, Southwark.
—	1	2	—	4	1	—	—	4	1	2	1	36	11	101	21	Newington.
—	—	1	—	1	—	—	—	1	—	—	—	3	—	7	—	St. Olave, Southwark.
3	1	2	—	4	1	2	—	3	—	1	—	40	3	120	27	Bermondsey.
3	—	—	1	1	—	5	—	1	1	—	—	20	4	77	10	Rotherhithe.
3	1	7	2	5	2	9	—	8	2	6	—	102	18	273	53	Lambeth.
7	2	6	1	1	—	8	—	2	—	4	—	58	6	205	32	Battersea.
3	2	5	3	1	—	2	1	8	—	6	2	44	9	153	27	Wandsworth.
2	—	4	—	9	1	8	2	9	1	8	2	86	14	186	33	Camberwell.
2	2	5	1	6	—	7	—	3	—	2	1	62	7	177	23	Greenwich.
2	—	1	—	3	1	1	—	2	1	—	—	18	6	59	14	Lewisham.
	—	—	—	—	—	—	—	1	—	1	—	16	1	23	3	Woolwich.
1	—	1	—	1	—	5	—	2	—	2	1	25	4	39	9	Plumstead.
1	—	1	—	—	—	—	—	—	1	—	—	2	1	18	4	Lee.
—	—	—	—	—	—	1	—	—	—	—	—	7	—	30	—	Port of London.

§ Including Inner Temple (population, 96).

‖ Including Tower of London (population, 868).

	Sanitary Areas.	Population (1891).	Simple Continued Fever. Weekly Statement, 1st Quarter, 1900. Jan. 6. Cases.	Jan. 6. Deaths.	Jan. 13. Cases.	Jan. 13. Deaths.	Jan. 20. Cases.	Jan. 20. Deaths.	Jan. 27. Cases.	Jan. 27. Deaths.	Feb. 3. Cases.	Feb. 3. Deaths.	Feb. 10. Cases.	Feb. 10. Deaths.	Feb. 17. Cases.	Feb. 17. Deaths.
	London (*Administrative County.*)	4,232,118	2	—	2	—	1	—	2	—	3	—	1	—	—	—
W. District.	Kensington	166,308	2	—	—	—	—	—	—	—	—	—	1	—	—	—
W. District.	Fulham	91,639	—	—	—	—	—	—	—	—	—	—	—	—	—	—
W. District.	Hammersmith	97,239	—	—	—	—	—	—	—	—	—	—	—	—	—	—
W. District.	Paddington	117,846	—	—	1	—	—	—	—	—	—	—	—	—	—	—
W. District.	Chelsea	96,253	—	—	—	—	—	—	—	—	—	—	—	—	—	—
W. District.	St. George, Hanover Sq.*	78,599	—	—	—	—	—	—	—	—	—	—	—	—	—	—
W. District.	Westminster	55,539	—	—	—	—	—	—	—	—	—	—	—	—	—	—
W. District.	St. James, Westminster	24,995	—	—	—	—	—	—	—	—	—	—	—	—	—	—
N. District.	St. Marylebone	142,404	—	—	—	—	—	—	—	—	—	—	—	—	—	—
N. District.	Hampstead	68,416	—	—	—	—	—	—	—	—	—	—	—	—	—	—
N. District.	St. Pancras	234,379	—	—	—	—	—	—	—	—	—	—	—	—	—	—
N. District.	Islington	319,143	—	—	—	—	—	—	1	—	2	—	—	—	—	—
N. District.	St. Mary, Stoke Newington	30,936	—	—	—	—	—	—	—	—	—	—	—	—	—	—
N. District.	Hackney	198,606	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Central District.	St. Giles and St. George, Bloomsbury.	39,782	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Central District.	St. Martin-in-the-Fields	14,616	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Central District.	Strand †	25,217	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Central District.	Holborn ‡	34,043	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Central District.	Clerkenwell	66,216	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Central District.	St. Luke, Middlesex	42,440	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Central District.	London, City of §	37,583	—	—	—	—	—	—	—	—	—	—	—	—	—	—
E. District.	Shoreditch	124,009	—	—	—	—	—	—	—	—	—	—	—	—	—	—
E. District.	Bethnal Green	129,132	—	—	1	—	—	—	—	—	—	—	—	—	—	—
E. District.	Whitechapel ‖	74,420	—	—	—	—	—	—	—	—	—	—	—	—	—	—
E. District.	St. George-in-the-East	45,795	—	—	—	—	—	—	—	—	—	—	—	—	—	—
E. District.	Limehouse	57,376	—	—	—	—	—	—	—	—	—	—	—	—	—	—
E. District.	Mile End Old Town	107,592	—	—	—	—	—	—	—	—	—	—	—	—	—	—
E. District.	Poplar	166,748	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	St. Saviour, Southwark	27,177	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	St. George, Southwark	59,712	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	Newington	115,804	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	St. Olave, Southwark	12,723	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	Bermondsey	84,682	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	Rotherhithe	39,255	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	Lambeth	275,203	—	—	—	—	1	—	—	—	—	—	—	—	—	—
S. District.	Battersea	150,558	—	—	—	—	—	—	1	—	—	—	—	—	—	—
S. District.	Wandsworth	156,942	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	Camberwell	235,344	—	—	—	—	—	—	—	—	1	—	—	—	—	—
S. District.	Greenwich	165,413	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	Lewisham	92,647	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	Woolwich	40,848	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	Plumstead	52,436	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	Lee	36,103	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	Port of London	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

* Including St. Peter's, Westminster (population, 235). † Including Middle Temple (population, 95).
‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).

Simple Continued Fever—*continued.*														Sanitary Areas.
Weekly Statement, 1st Quarter, 1900—*continued.*												Totals for 1st Quarter, 1900.		
Feb. 24.		Mar. 3.		Mar. 10.		Mar. 17.		Mar. 24.		Mar. 31.				
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
2	—	—	—	2	—	—	—	—	—	—	—	15	—	London. (*Administrative County.*)
1	—	—	—	1	—	—	—	—	—	—	—	5	—	Kensington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Fulham.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Hammersmith.
—	—	—	—	—	—	—	—	—	—	—	—	1	—	Paddington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Chelsea.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. George, Hanover Sq.*
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Westminster.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. James, Westminster.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Marylebone.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Hampstead.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Pancras.
—	—	—	—	1	—	—	—	—	—	—	—	4	—	Islington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Mary, Stoke Newington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Hackney.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Giles and St. George, Bloomsbury.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Martin-in-the-Fields.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Strand. †
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Holborn. ‡
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Clerkenwell.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Luke, Middlesex.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	London, City of. §
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Shoreditch.
—	—	—	—	—	—	—	—	—	—	—	—	1	—	Bethnal Green.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Whitechapel. ‖
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. George-in-the-East.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Limehouse.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Mile End Old Town.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Poplar.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Saviour, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. George, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Newington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Olave, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Bermondsey.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Rotherhithe.
1	—	—	—	—	—	—	—	—	—	—	—	2	—	Lambeth.
—	—	—	—	—	—	—	—	—	—	—	—	1	—	Battersea.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Wandsworth.
—	—	—	—	—	—	—	—	—	—	—	—	1	—	Camberwell
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Greenwich.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Lewisham
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Woolwich.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Plumstead.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Lee.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Port of London.

§ Including Inner Temple (population, 96).   ‖ Including Tower of London (population, 866).

Sanitary Areas.		Population 1891).	SIMPLE CONTINUED FEVER—*continued.* Weekly Statement, 2nd Quarter, 1900. Apr. 7. Cases.	Apr. 7. Deaths.	Apr. 14. Cases.	Apr. 14. Deaths.	Apr. 21. Cases.	Apr. 21. Deaths.	Apr. 28. Cases.	Apr. 28. Deaths.	May 5. Cases.	May 5. Deaths.	May 12. Cases.	May 12. Deaths.	May 19. Cases.	May 19. Deaths.
London .. .. (*Administrative County.*)		4,232,118	1	—	—	—	3	—	1	—	3	—	—	—	2	—
Kensington	W. District.	166,308	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Fulham	W. District.	91,639	—	—	—	—	1	—	—	—	1	—	—	—	—	—
Hammersmith	W. District.	97,239	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Paddington	W. District.	117,846	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Chelsea..	W. District.	96,253	—	—	—	—	—	—	—	—	—	—	—	—	—	—
St. George, Hanover Sq.* ..	W. District.	78,599	—	—	—	—	—	—	1	—	—	—	—	—	—	—
Westminster	W. District.	55,539	—	—	—	—	—	—	—	—	—	—	—	—	—	—
St. James, Westminster ..	W. District.	24,995	—	—	—	—	—	—	—	—	—	—	—	—	—	—
St. Marylebone	N. District.	142,404	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Hampstead	N. District.	68,416	—	—	—	—	—	—	—	—	—	—	—	—	—	—
St. Pancras	N. District.	234,379	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Islington	N. District.	319,143	—	—	—	—	—	—	—	—	—	—	—	—	—	—
St. Mary, Stoke Newington	N. District.	30,936	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Hackney	N. District.	198,606	—	—	—	—	—	—	—	—	—	—	—	—	2	—
St. Giles and St. George, Bloomsbury.	Central District.	39,782	—	—	—	—	—	—	—	—	—	—	—	—	—	—
St. Martin-in the-Fields ..	Central District.	14,616	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Strand†	Central District.	25,217	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Holborn‡	Central District.	34,043	—	—	—	—	—	—	—	—	1	—	—	—	—	—
Clerkenwell	Central District.	66,216	—	—	—	—	—	—	—	—	—	—	—	—	—	—
St. Luke, Middlesex ..	Central District.	42,440	—	—	—	—	—	—	—	—	—	—	—	—	—	—
London, City of§	Central District.	37,583	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Shoreditch	E. District.	124,009	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Bethnal Green	E. District.	129,132	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Whitechapel‖	E. District.	74,420	—	—	—	—	—	—	—	—	—	—	—	—	—	—
St. George-in-the-East ..	E. District.	45,795	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Limehouse	E. District.	57,376	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Mile End Old Town ..	E. District.	107,592	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Poplar	E. District.	166,748	—	—	—	—	—	—	—	—	1	—	—	—	—	—
St. Saviour, Southwark ..	S. District.	27,177	—	—	—	—	—	—	—	—	—	—	—	—	—	—
St. George, Southwark ..	S. District.	59,712	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Newington	S. District.	115,804	—	—	—	—	—	—	—	—	—	—	—	—	—	—
St. Olave, Southwark ..	S. District.	12,723	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Bermondsey	S. District.	84,682	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Rotherhithe	S. District.	39,255	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Lambeth	S. District.	275,203	—	—	—	—	2	—	—	—	—	—	—	—	—	—
Battersea	S. District.	150,558	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Wandsworth	S. District.	156,942	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Camberwell	S. District.	235,344	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Greenwich	S. District.	165,413	1	—	—	—	—	—	—	—	—	—	—	—	—	—
Lewisham	S. District.	92,647	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Woolwich	S. District.	40,848	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Plumstead	S. District.	52,436	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Lee	S. District.	36,103	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Port of London	S. District.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

* Including St. Peter's, Westminster (population, 235). † Including Middle Temple (population, 95).
‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn, (population, 121).

SIMPLE CONTINUED FEVER—*continued.*

Weekly Statement, 2nd Quarter, 1900—*continued.*												Totals for 2nd Quarter, 1900.		Sanitary Areas.
May 26.		June 2.		June 9.		June 16.		June 23.		June 30.				
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
2	—	1	—	—	1	2	1	—	—	1	—	16	2	London. (*Administrative County.*)
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Kensington.
—	—	—	—	—	—	—	—	—	—	—	—	2	—	Fulham.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Hammersmith.
—	—	1	—	—	—	—	—	—	—	—	—	1	—	Paddington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Chelsea.
—	—	—	—	—	—	—	—	—	—	—	—	1	—	St. George, Hanover Sq.*
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Westminster.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. James, Westminster.
—	—	—	—	—	—	—	1	—	—	—	—	—	1	St. Marylebone.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Hampstead.
—	—	—	—	—	—	1	—	—	—	—	—	1	—	St. Pancras.
—	—	—	—	—	—	1	—	—	—	—	—	1	—	Islington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Mary, Stoke Newington.
—	—	—	—	—	—	—	—	—	—	—	—	2	—	Hackney.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Giles and St. George, Bloomsbury.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Martin-in-the-Fields.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Strand†.
—	—	—	—	—	—	—	—	—	—	—	—	1	—	Holborn.‡
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Clerkenwell.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Luke, Middlesex.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	London, City of.§
—	—	—	—	—	1	—	—	—	—	—	—	—	1	Shoreditch.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Bethnal Green.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Whitechapel.‖
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. George-in-the-East.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Limehouse.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Mile End Old Town.
—	—	—	—	—	—	—	—	—	—	—	—	1	—	Poplar.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Saviour, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. George, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Newington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Olave, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Bermondsey.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Rotherhithe.
2	—	—	—	—	—	—	—	—	—	1	—	5	—	Lambeth.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Battersea.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Wandsworth.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Camberwell.
—	—	—	—	—	—	—	—	—	—	—	—	1	—	Greenwich.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Lewisham.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Woolwich.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Plumstead.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Lee.
—	—	—	—	—	—	—	—	—	—		—	—	—	Port of London.

§ Including Inner Temple (population, 96).

‖ Including Tower of London (population, 868).

District	Sanitary Areas.	Population (1891).	July 7. Cases.	July 7. Deaths.	July 14. Cases.	July 14. Deaths.	July 21. Cases.	July 21. Deaths.	July 28. Cases.	July 28. Deaths.	Aug. 4. Cases.	Aug. 4. Deaths.	Aug. 11. Cases.	Aug. 11. Deaths.	Aug. 18. Cases.	Aug. 18. Deaths.
	SIMPLE CONTINUED FEVER—*continued.* Weekly Statement, 3rd Quarter, 1900.															
	London .. .. (*Administrative County.*)	4,232,118	—	—	4	—	2	1	2	1	2	—	—	—	1	1
W. District.	Kensington	166,308	—	—	1	—	—	—	—	—	—	—	—	—	—	—
	Fulham	91,639	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Hammersmith	97,239	—	—	—	—	—	—	—	—	1	—	—	—	—	—
	Paddington	117,846	—	—	—	—	1	1	—	—	—	—	—	—	—	—
	Chelsea	96,253	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. George, Hanover Sq.*	78,599	—	—	1	—	—	—	—	—	—	—	—	—	—	—
	Westminster	55,539	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. James, Westminster ..	24,995	—	—	—	—	—	—	—	—	—	—	—	—	—	—
N. District.	St. Marylebone	142,404	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Hampstead	68,416	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. Pancras	234,379	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Islington	319,143	—	—	—	—	—	—	—	1	—	—	—	—	—	—
	St. Mary, Stoke Newington	30,936	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Hackney	198,606	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Central District.	St. Giles and St. George, Bloomsbury.	39,782	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. Martin-in-the-Fields ..	14,616	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Strand†	25,217	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Holborn‡	34,043	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Clerkenwell	66,216	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. Luke, Middlesex ..	42,440	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	London, City of §	37,583	—	—	—	—	—	—	—	—	—	—	—	—	—	—
E. District.	Shoreditch	124,009	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Bethnal Green	129,132	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Whitechapel‖	74,420	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. George-in-the-East ..	45,795	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Limehouse	57,376	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Mile End Old Town ..	107,592	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Poplar	166,748	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	St. Saviour, Southwark ..	27,177	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. George, Southwark ..	59,712	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Newington	115,804	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. Olave, Southwark ..	12,723	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Bermondsey	84,682	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Rotherhithe	39,255	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Lambeth	275,203	—	—	1	—	1	—	2	—	1	—	—	—	1	1
	Battersea	150,558	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Wandsworth	156,942	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Camberwell	235,344	—	—	1	—	—	—	—	—	—	—	—	—	—	—
	Greenwich	165,413	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Lewisham	92,647	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Woolwich	40,848	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Plumstead	52,436	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Lee	36,103	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Port of London	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

* Including St. Peter's, Westminster (population, 235). † Including Middle Temple (population, 95).
‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).

Simple Continued Fever—*continued.* Weekly Statement, 3rd Quarter, 1900—*continued.* Aug. 25.		Sept. 1.		Sept. 8.		Sept. 15.		Sept. 22.		Sept. 29.		Totals for 3rd Quarter, 1900.		Sanitary Areas.
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
2	1	1	1	1	—	4	—	3	—	—	—	22	5	London.
														(*Administrative County.*)
—	—	—	—	—	—	1	—	—	—	—	—	2	—	Kensington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Fulham.
—	—	—	—	—	—	—	—	—	—	—	—	1	—	Hammersmith.
—	—	—	—	—	—	—	—	—	—	—	—	1	1	Paddington.
—	—	—	—	—	—	1	—	1	—	—	—	2	—	Chelsea.
1	—	—	—	—	—	—	—	—	—	—	—	2	—	St. George, Hanover Sq.*
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Westminster.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. James, Westminster.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Marylebone.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Hampstead.
—	—	—	1	—	—	—	—	—	—	—	—	—	1	St. Pancras.
—	—	—	—	—	—	—	—	—	—	—	—	—	1	Islington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Mary, Stoke Newington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Hackney.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Giles and St. George, Bloomsbury.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Martin-in-the-Fields.
—	—	—	—	1	—	—	—	—	—	—	—	1	—	Strand.†
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Holborn.‡
—	—	—	—	—	—	1	—	—	—	—	—	1	—	Clerkenwell.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Luke, Middlesex.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	London, City of.§
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Shoreditch.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Bethnal Green.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Whitechapel.‖
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. George-in-the-East.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Limehouse.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Mile End Old Town.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Poplar.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Saviour, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. George, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Newington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Olave, Southwark.
—	—	—	—	—	—	—	—			—	—			Bermondsey.
—	—	—	—	—	—	—	—			—	—			Rotherhithe.
1	—	—	—	—	—	—	—	2		—	—	9	1	Lambeth.
—	—	—								—	—			Battersea.
—	1	—								—			1	Wandsworth.
—	—	1								—		2		Camberwell.
—	—	—						—	—	—				Greenwich.
—	—	—						—	—	—			—	Lewisham.
—	—	—						—	—	—			—	Woolwich.
—	—	—				—	—	—	—	—			—	Plumstead.
—	—	—	—	—	—	—	—	—	—	—			—	Lee.
—	—	—	—	—	—	—	—	—	—	—			—	Port of London.

§ Including Inner Temple (population, 96). ‖ Including Tower of London (population, 868)

District	Sanitary Areas.	Population (1891).	Simple Continued Fever—continued. Weekly Statement, 4th Quarter, 1900. Oct. 6. Cases.	Oct. 6. Deaths.	Oct. 13. Cases.	Oct. 13. Deaths.	Oct. 20. Cases.	Oct. 20. Deaths.	Oct. 27. Cases.	Oct. 27. Deaths.	Nov. 3. Cases.	Nov. 3. Deaths.	Nov. 10. Cases.	Nov. 10. Deaths.	Nov. 17. Cases.	Nov. 17. Deaths.
	London .. .. (*Administrative County.*)	4,232,118	3	—	2	—	1	—	3	—	2	—	3	—	2	—
W. District.	Kensington	166,308	—	—	—	—	1	—	—	—	—	—	—	—	—	—
W. District.	Fulham	91,639	—	—	—	—	—	—	—	—	—	—	—	—	—	—
W. District.	Hammersmith	97,239	—	—	—	—	—	—	—	—	—	—	—	—	—	—
W. District.	Paddington	117,846	—	—	—	—	—	—	—	—	—	—	—	—	—	—
W. District.	Chelsea..	96,253	—	—	1	—	—	—	—	—	—	—	—	—	—	—
W. District.	St. George, Hanover Sq.* ..	78,599	—	—	—	—	—	—	—	—	—	—	—	—	—	—
W. District.	Westminster	55,539	—	—	—	—	—	—	—	—	—	—	—	—	—	—
W. District.	St. James, Westminster ..	24,995	—	—	—	—	—	—	—	—	—	—	—	—	—	—
N. District.	St. Marylebone	142,404	—	—	—	—	—	—	—	—	—	—	—	—	—	—
N. District.	Hampstead	68,416	—	—	—	—	—	—	—	—	—	—	—	—	—	—
N. District.	St. Pancras	234,379	—	—	—	—	—	—	—	—	—	—	—	—	—	—
N. District.	Islington	319,143	—	—	—	—	—	—	1	—	—	—	—	—	—	—
N. District.	St. Mary, Stoke Newington	30,936	—	—	—	—	—	—	—	—	—	—	—	—	—	—
N. District.	Hackney	198,606	—	—	—	—	—	—	1	—	1	—	1	—	—	—
Central District.	St. Giles and St. George, Bloomsbury.	39,782	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Central District.	St. Martin-in-the-Fields ..	14,616	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Central District.	Strand†	25,217	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Central District.	Holborn‡	34,043	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Central District.	Clerkenwell	66,216	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Central District.	St. Luke, Middlesex ..	42,440	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Central District.	London, City of§	37,583	—	—	—	—	—	—	—	—	—	—	—	—	—	—
E. District.	Shoreditch	124,009	—	—	—	—	—	—	—	—	—	—	1	—	—	—
E. District.	Bethnal Green	129,132	—	—	—	—	—	—	—	—	—	—	—	—	—	—
E. District.	Whitechapel‖	74,420	—	—	—	—	—	—	—	—	—	—	—	—	—	—
E. District.	St. George-in-the-East ..	45,795	—	—	—	—	—	—	—	—	—	—	—	—	—	—
E. District.	Limehouse	57,376	—	—	—	—	—	—	—	—	—	—	—	—	—	—
E. District.	Mile End Old Town ..	107,592	—	—	—	—	—	—	—	—	—	—	—	—	—	—
E. District.	Poplar	166,748	—	—	—	—	—	—	—	—	—	—	—	—	1	—
S. District.	St. Saviour, Southwark ..	27,177	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	St. George, Southwark ..	59,712	—	—	—	—	—	—	—	—	—	—	1	—	—	—
S. District.	Newington	115,804	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	St. Olave, Southwark ..	12,723	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	Bermondsey	84,682	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	Rotherhithe	39,255	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	Lambeth	275,203	1	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	Battersea	150,558	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	Wandsworth	156,942	—	—	—	—	—	—	—	—	1	—	—	—	—	—
S. District.	Camberwell	235,344	2	—	—	—	—	—	1	—	—	—	—	—	—	—
S. District.	Greenwich	165,413	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	Lewisham	92,647	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	Woolwich	40,848	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	Plumstead	52,436	—	—	1	—	—	—	—	—	—	—	—	—	1	—
S. District.	Lee	36,103	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	Port of London	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

* Including St. Peter's, Westminster (population, 235). † Including Middle Temple (population, 96).
‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).

SIMPLE CONTINUED FEVER—*continued.*

Weekly Statement, 4th Quarter, 1900—*continued.*											Totals for 4th Quarter, 1900.		Grand Totals for Year, 1900.		Sanitary Areas.
...r. 24.	Dec. 1.		Dec. 8.		Dec. 15.		Dec. 22.		Dec. 29.						
Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
—	—	—	2	—	1	—	1	—	—	—	20	—	73	7	London. (*Administrative County.*)
—	—	—	1	—	—	—	1	—	—	—	3	—	10	—	Kensington.
—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	Fulham.
—	—	—	1	—	—	—	—	—	—	—	1	—	2	—	Hammersmith.
—	—	—	—	—	—	—	—	—	—	—	—	—	3	1	Paddington.
—	—	—	—	—	—	—	—	—	—	—	1	—	3	—	Chelsea.
—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	St. George, Hanover Sq.*
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Westminster.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. James, Westminster.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	St. Marylebone.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Hampstead.
—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	St. Pancras.
—	—	—	—	—	—	—	—	—	—	—	1	—	6	1	Islington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Mary, Stoke Newington.
—	—	—	—	—	—	—	—	—	—	—	3	—	5	—	Hackney.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Giles and St. George, Bloomsbury.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Martin-in-the-Fields.
—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Strand.†
—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Holborn.‡
—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Clerkenwell.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Luke, Middlesex.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	London, City of.§
—	—	—	—	—	1	—	—	—	—	—	2	—	2	1	Shoreditch.
—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Bethnal Green.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Whitechapel.‖
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. George-in-the-East.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Limehouse.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Mile End Old Town.
—	—	—	—	—	—	—	—	—	—	—	1	—	2	—	Poplar.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Saviour, Southwark.
—	—	—	—	—	—	—	—	—	—	—	1	—	1	—	St. George, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Newington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Olave, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Bermondsey.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Rotherhithe.
—	—	—	—	—	—	—	—	—	—	—	1	—	17	1	Lambeth.
—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	Battersea.
—	—	—	—	—	—	—	—	—	—	—	1	—	1	1	Wandsworth.
—	—	—	—	—	—	—	—	—	—	—	3	—	6	—	Camberwell.
—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	Greenwich.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Lewisham.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Woolwich.
—	—	—	—	—	—	—	—	—	—	—	2	—	2	—	Plumstead.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Lee.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Port of London.

§ Including Inner Temple (population, 96). ‖ Including Tower of London (population, 968).

	Sanitary Areas.	Population (1891).	TYPHUS FEVER. Weekly Statement, 1900. Jan. 27. Cases.	Feb. 17. Cases.	Totals for 1st Quarter, 1900. Cases.	Totals for 1st Quarter, 1900. Deaths.	May 12. Cases.	June 30. Cases.	Totals for 2nd Quarter, 1900. Cases.	Totals for 2nd Quarter, 1900. Deaths.
	London .. .. (*Administrative County.*)	4,232,118	1	1	2	—	1	1	2	—
W. District.	Kensington	166,308	—	—	—	—	—	—	—	—
W. District.	Fulham	91,639	—	—	—	—	—	—	—	—
W. District.	Hammersmith	97,239	—	—	—	—	—	—	—	—
W. District.	Paddington	117,846	1	—	1	—	—	—	—	—
W. District.	Chelsea	96,253	—	—	—	—	—	—	—	—
W. District.	St. George, Hanover Sq. * ..	78,599	—	—	—	—	—	—	—	—
W. District.	Westminster	55,539	—	—	—	—	—	—	—	—
W. District.	St. James, Westminster ..	24,995	—	—	—	—	—	—	—	—
N. District.	St. Marylebone	142,404	—	—	—	—	—	—	—	—
N. District.	Hampstead	68,416	—	—	—	—	—	—	—	—
N. District.	St. Pancras	234,379	—	—	—	—	—	—	—	—
N. District.	Islington	319,143	—	—	—	—	—	1	1	—
N. District.	St. Mary, Stoke Newington ..	30,936	—	—	—	—	—	—	—	—
N. District.	Hackney	198,606	—	—	—	—	—	—	—	—
Central District.	St. Giles and St. George, Bloomsbury.	39,782	—	—	—	—	—	—	—	—
Central District.	St. Martin-in-the-Fields ..	14,616	—	—	—	—	—	—	—	—
Central District.	Strand †	25,217	—	—	—	—	—	—	—	—
Central District.	Holborn ‡	34,043	—	—	—	—	—	—	—	—
Central District.	Clerkenwell	66,216	—	—	—	—	—	—	—	—
Central District.	St. Luke, Middlesex	42,440	—	—	—	—	—	—	—	—
Central District.	London, City of §	37,583	—	—	—	—	—	—	—	—
E. District.	Shoreditch	124,009	—	—	—	—	—	—	—	—
E. District.	Bethnal Green	129,132	—	—	—	—	—	—	—	—
E. District.	Whitechapel ‖	74,420	—	1	1	—	—	—	—	—
E. District.	St. George-in-the-East ..	45,795	—	—	—	—	—	—	—	—
E. District.	Limehouse	57,376	—	—	—	—	—	—	—	—
E. District.	Mile End Old Town	107,592	—	—	—	—	—	—	—	—
E. District.	Poplar	166,748	—	—	—	—	1	—	1	—
S. District.	St. Saviour, Southwark ..	27,177	—	—	—	—	—	—	—	—
S. District.	St. George, Southwark ..	59,712	—	—	—	—	—	—	—	—
S. District.	Newington	115,804	—	—	—	—	—	—	—	—
S. District.	St. Olave, Southwark	12,723	—	—	—	—	—	—	—	—
S. District.	Bermondsey	84,682	—	—	—	—	—	—	—	—
S. District.	Rotherhithe	39,255	—	—	—		—	—	—	—
S. District.	Lambeth	275,203	—	—	—	—	—	—	—	—
S. District.	Battersea	150,558	—	—	—	—	—	—	—	—
S. District.	Wandsworth	156,942	—	—	—	—	—	—	—	—
S. District.	Camberwell	235,344	—	—	—	—	—	—	—	—
S. District.	Greenwich	165,413	—	—	—	—	—	—	—	—
S. District.	Lewisham	92,647	—	—	—	—	—	—	—	—
S. District.	Woolwich	40,848	—	—	—	—	—	—	—	—
S. District.	Plumstead	52,436	—	—	—	—	—	—	—	—
S. District.	Lee	36,103	—	—	—	—	—	—	—	—
S. District.	Port of London	—	—	—	—	—	—	—	—	—

* Including St. Peter's, Westminster (population, 235). † Including Middle Temple (population, [illegible]).
‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, [illegible]), Staple Inn (population, 21), and Furnival's Inn (population, 121).

TYPHUS FEVER—*continued*.											
Weekly Statement, 1900—*continued*.									Grand Totals for Year, 1900.		Sanitary Areas.
Aug. 18.		Sept. 8.	Totals for 3rd Quarter, 1900.		Oct. 13.	Dec. 1.	Totals for 4th Quarter, 1900.				
Cases.	Deaths.	Cases.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
1	1	1	2	1	1	1	1	1	7	2	London. (*Administrative County.*)
—	—	—	—	—	—	—	—	—	—	—	Kensington.
—	—	—	—	—	—	—	—	—	—	—	Fulham.
—	—	—	—	—	—	—	—	—	—	—	Hammersmith.
1	1	—	1	1	—	—	—	—	2	1	Paddington.
—	—	1	1	—	—	—	—	—	1	—	Chelsea.
—	—	—	—	—	—	1	—	1	—	1	St. George, Hanover Sq *
—	—	—	—	—	—	—	—	—	—	—	Westminster.
—	—	—	—	—	—	—	—	—	—	—	St. James, Westminster.
—	—	—	—	—	—	—	—	—	—	—	St. Marylebone.
—	—	—	—	—	—	—	—	—	—	—	Hampstead
—	—	—	—	—	—	—	—	—	—	—	St. Pancras
—	—	—	—	—	—	—	—	—	1	—	Islington.
—	—	—	—	—	—	—	—	—	—	—	St.Mary,Stoke Newington
—	—	—	—	—	1	—	1	—	1	—	Hackney.
—	—	—	—	—	—	—	—	—	—	—	St. Giles and St. George, Bloomsbury.
—	—	—	—	—	—	—	—	—	—	—	St. Martin-in-the-Fields.
—	—	—	—	—	—	—	—	—	—	—	Strand.†
—	—	—	—	—	—	—	—	—	—	—	Holborn.‡
—	—	—	—	—	—	—	—	—	—	—	Clerkenwell.
—	—	—	—	—	—	—	—	—	—	—	St. Luke, Middlesex.
—	—	—	—	—	—	—	—	—	—	—	London, City of.§
—	—	—	—	—	—	—	—	—	—	—	Shoreditch.
—	—	—	—	—	—	—	—	—	—	—	Bethnal Green.
—	—	—	—	—	—	—	—	—	1	—	Whitechapel.
—	—	—	—	—	—	—	—	—	—	—	St. George-in-the-East.
—	—	—	—	—	—	—	—	—	—	—	Limehouse.
—	—	—	—	—	—	—	—	—	—	—	Mile End Old Town.
—	—	—	—	—	—	—	—	—	1	—	Poplar.
—	—	—	—	—	—	—	—	—	—	—	St. Saviour, Southwark.
—	—	—	—	—	—	—	—	—	—	—	St. George, Southwark.
—	—	—	—	—	—	—	—	—	—	—	Newington.
—	—	—	—	—	—	—	—	—	—	—	St. Olave, Southwark.
—	—	—	—	—	—	—	—	—	—	—	Bermondsey.
—	—	—	—	—	—	—	—	—	—	—	Rotherhithe.
—	—	—	—	—	—	—	—	—	—	—	Lambeth.
—	—	—	—	—	—	—	—	—	—	—	Battersea.
—	—	—	—	—	—	—	—	—	—	—	Wandsworth.
—	—	—	—	—	—	—	—	—	—	—	Camberwell.
—	—	—	—	—	—	—	—	—	—	—	Greenwich.
—	—	—	—	—	—	—	—	—	—	—	Lewisham.
—	—	—	—	—	—	—	—	—	—	—	Woolwich.
—	—	—	—	—	—	—	—	—	—	—	Plumstead.
—	—	—	—	—	—	—	—	—	—	—	Lee.
—	—	—	—	—	—	—	—	—	—	—	Port of London.

§ Including Inner Temple (population, 96). ‖ Including Tower of London (population, [illegible]).

Sanitary Areas.		Population (1891).	Typhus Fever. Weekly Statement, 1900. Jan. 27. Cases.	Feb. 17. Cases.	Totals for 1st Quarter, 1900. Cases.	Totals for 1st Quarter, 1900. Deaths.	May 12. Cases.	June 30. Cases.	Totals for 2nd Quarter, 1900. Cases.	Totals for 2nd Quarter, 1900. Deaths.
London .. .. (*Administrative County.*)		4,232,118	1	1	2	—	1	1	2	—
W. District.	Kensington	166,308	—	—	—	—	—	—	—	—
	Fulham	91,639	—	—	—	—	—	—	—	—
	Hammersmith	97,239	—	—	—	—	—	—	—	—
	Paddington	117,846	1	—	1	—	—	—	—	—
	Chelsea	96,253	—	—	—	—	—	—	—	—
	St. George, Hanover Sq. * ..	78,599	—	—	—	—	—	—	—	—
	Westminster	55,539	—	—	—	—	—	—	—	—
	St. James, Westminster ..	24,995	—	—	—	—	—	—	—	—
N. District.	St. Marylebone	142,404	—	—	—	—	—	—	—	—
	Hampstead	68,416	—	—	—	—	—	—	—	—
	St. Pancras	234,379	—	—	—	—	—	—	—	—
	Islington	319,143	—	—	—	—	—	1	1	—
	St. Mary, Stoke Newington ..	30,936	—	—	—	—	—	—	—	—
	Hackney	198,606	—	—	—	—	—	—	—	—
Central District.	St. Giles and St. George, Bloomsbury.	39,782	—	—	—	—	—	—	—	—
	St. Martin-in-the-Fields ..	14,616	—	—	—	—	—	—	—	—
	Strand †	25,217	—	—	—	—	—	—	—	—
	Holborn ‡	34,043	—	—	—	—	—	—	—	—
	Clerkenwell	66,216	—	—	—	—	—	—	—	—
	St. Luke, Middlesex	42,440	—	—	—	—	—	—	—	—
	London, City of §	37,583	—	—	—	—	—	—	—	—
E. District.	Shoreditch	124,009	—	—	—	—	—	—	—	—
	Bethnal Green	129,132	—	—	—	—	—	—	—	—
	Whitechapel ‖	74,420	—	1	1	—	—	—	—	—
	St. George-in-the-East ..	45,795	—	—	—	—	—	—	—	—
	Limehouse	57,376	—	—	—	—	—	—	—	—
	Mile End Old Town	107,592	—	—	—	—	—	—	—	—
	Poplar	166,748	—	—	—	—	1	—	1	—
S. District.	St. Saviour, Southwark ..	27,177	—	—	—	—	—	—	—	—
	St. George, Southwark ..	59,712	—	—	—	—	—	—	—	—
	Newington	115,804	—	—	—	—	—	—	—	—
	St. Olave, Southwark	12,723	—	—	—	—	—	—	—	—
	Bermondsey	84,682	—	—	—	—	—	—	—	—
	Rotherhithe	39,255	—	—	—		—	—	—	—
	Lambeth	275,203	—	—	—	—	—	—	—	—
	Battersea	150,558	—	—	—	—	—	—	—	—
	Wandsworth	156,942	—	—	—	—	—	—	—	—
	Camberwell	235,344	—	—	—	—	—	—	—	—
	Greenwich	165,413	—	—	—	—	—	—	—	—
	Lewisham	92,647	—	—	—	—	—	—	—	—
	Woolwich	40,818	—	—	—	—	—	—	—	—
	Plumstead	52,436	—	—	—	—	—	—	—	—
	Lee	36,103	—	—	—	—	—	—	—	—
	Port of London	—	—	—	—	—	—	—	—	—

* Including St. Peter's, Westminster (population, 235). † Including Middle Temple (population, [illegible]).
‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 1[illegible]), Staple Inn (population, 21), and Furnival's Inn (population, 121).

TYPHUS FEVER—*continued*.											
Weekly Statement, 1900—*continued*.									Grand Totals for Year, 1900.		Sanitary Areas.
Aug. 18.		Sept. 8.	Totals for 3rd Quarter, 1900.		Oct. 13.	Dec. 1.	Totals for 4th Quarter, 1900.				
Cases.	Deaths.	Cases.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
1	1	1	2	1	1	1	1	1	7	2	London. (*Administrative County.*)
—	—	—	—	—	—	—	—	—	—	—	Kensington.
—	—	—	—	—	—	—	—	—	—	—	Fulham.
—	—	—	—	—	—	—	—	—	—	—	Hammersmith.
1	1	—	1	1	—	—	—	—	2	1	Paddington.
—	—	1	1	—	—	—	—	—	1	—	Chelsea.
—	—	—	—	—	—	1	—	1	—	1	St. George, Hanover Sq.*
—	—	—	—	—	—	—	—	—	—	—	Westminster.
—	—	—	—	—	—	—	—	—	—	—	St. James, Westminster.
—	—	—	—	—	—	—	—	—	—	—	St. Marylebone.
—	—	—	—	—	—	—	—	—	—	—	Hampstead
—	—	—	—	—	—	—	—	—	—	—	St. Pancras
—	—	—	—	—	—	—	—	—	1	—	Islington.
—	—	—	—	—	—	—	—	—	—	—	St.Mary,Stoke Newington
—	—	—	—	—	1	—	1	—	1	—	Hackney.
—	—	—	—	—	—	—	—	—	—	—	St. Giles and St. George, Bloomsbury.
—	—	—	—	—	—	—	—	—	—	—	St. Martin-in-the-Fields.
—	—	—	—	—	—	—	—	—	—	—	Strand.†
—	—	—	—	—	—	—	—	—	—	—	Holborn.‡
—	—	—	—	—	—	—	—	—	—	—	Clerkenwell.
—	—	—	—	—	—	—	—	—	—	—	St. Luke, Middlesex.
—	—	—	—	—	—	—	—	—	—	—	London, City of.§
—	—	—	—	—	—	—	—	—	—	—	Shoreditch.
—	—	—	—	—	—	—	—	—	—	—	Bethnal Green.
—	—	—	—	—	—	—	—	—	1	—	Whitechapel.
—	—	—	—	—	—	—	—	—	—	—	St. George-in-the-East.
—	—	—	—	—	—	—	—	—	—	—	Limehouse.
—	—	—	—	—	—	—	—	—	—	—	Mile End Old Town.
—	—	—	—	—	—	—	—	—	1	—	Poplar.
—	—	—	—	—	—	—	—	—	—	—	St. Saviour, Southwark.
—	—	—	—	—	—	—	—	—	—	—	St. George, Southwark.
—	—	—	—	—	—	—	—	—	—	—	Newington.
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—	—	—	—	—	—	—	—	—	—	—	Lewisham.
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—	—	—	—	—	—	—	—	—	—	—	Plumstead.
—	—	—	—	—	—	—	—	—	—	—	Lee.
—	—	—	—	—	—	—	—	—	—	—	Port of London.

§ Including Inner Temple (population, 96).

‖ Including Tower of London (population, [illegible]).

No. 16.

App. A, No. 16.

Memoranda prepared or revised in the Medical Department during 1900.

Memoranda Prepared or Revised in the Medical Department during 1900.

(1.) On the Provision of Isolation Hospital Accommodation by Local Authorities. Revised, August, 1900.

(2.) Plague Memorandum. Prepared, September, 1900.

(3.) Directions for the use of the Haffkine Plague Prophylactic. Prepared, September, 1900.

(4.) Directions for obtaining and forwarding for Bacterioscopic Examination Material from Suspected Plague Cases. Prepared, September, 1900.

(5.) General Memorandum on the Proceedings which are advisable in places attacked or threatened by Epidemic Disease. Revised, September, 1900.

(6.) Memorandum as to Annual Reports of Medical Officers of Health (London). Revised, December, 1900.

(7.) Memorandum as to Annual Reports of Medical Officers of Health (Provinces). Revised, December, 1900.

(1.)

On the Provision of Isolation Hospital Accommodation by Local Authorities.

This memorandum is designed to represent to those who are responsible for the health of communities the importance of providing hospital accommodation for the isolation of cases of infectious disease, and of doing so before the actual invasion of their districts by such disease. It is further intended to indicate to local authorities, more especially to those of districts of small or moderate size, the means by which they may most advantageously make such provision. Some general principles to be held in view by all authorities who propose to provide, by means of loans sanctioned by the Local Government Board, isolation hospitals for their districts will be set forth in the course of the memorandum. Those in italics are points which the Board regard as indispensable.

The provision of hospital accommodation for cases of infectious diseases is to be regarded primarily as a measure of sanitary defence, for the protection of the public against the spread of these diseases. It is true that such accommodation incidentally serves

other useful purposes. Thus, it is frequently of value for the relief of individuals suffering from infectious disease, whose sufferings may be alleviated and their recovery promoted by affording them better accommodation and attendance than they are able to obtain at their own homes. Or it may be the means of avoiding serious inconvenience and pecuniary loss, as when infectious disease breaks out in a school, a lodging house, or a place of business. But, nevertheless, the most important function which such a hospital serves is that of the isolation of the first cases of infectious disease with a view to preventing its further spread in the household or locality invaded.

In order that a hospital may fulfil this function it is essential that it should be in readiness beforehand. Experience has shown that on the invasion of an epidemic, a hospital, even of a temporary kind, can seldom be provided and got ready for use until the time when it would have been of most service is past. The accommodation, moreover, which is required when an epidemic has become established is on a larger scale than would have sufficed for the isolation of the first cases; and hospitals hurriedly erected during the stress of an epidemic are never satisfactory in construction or suited to the permanent needs of the district.

An isolation hospital being intended primarily for the protection of the public at large rather than for the benefit of individuals, it is undesirable that admission should be subject to restrictive charges and conditions which may tend to prevent the use of the hospital by the poorer portion of the community; that is to say, by those who have the least facilities for isolation and treatment at their own homes. In some districts, however, *e.g.*, at health resorts, it may be advisable to provide special accommodation of a superior kind, such as private wards, for persons willing to pay for it.

Area to be served by a hospital.—The extent of area for which an isolation hospital may serve will depend in some degree upon considerations of local topography. If the area be too large the usefulness of the hospital will be diminished, owing to the difficulties attending the conveyance of patients over long distances. But, on the other hand, the unnecessary multiplication of small hospitals is to be avoided on grounds both of economy and of efficiency. As compared with that of several smaller hospitals, the establishment of a single hospital containing an equal number of beds saves the cost of duplicating various buildings, appliances, and officers; it facilitates the classification of patients according to the diseases from which they are suffering; and it enables a more efficient staff to be maintained, since the hospital is less likely to remain empty for considerable periods. Hence, where districts are not very large or populous, combination for the purpose of providing hospital accommodation is often of advantage. In the less densely populated parts of the country, a market town with the surrounding rural district, or the several sanitary districts comprised in one poor law union, may form a convenient area for the purpose of combined hospital provision. A hospital intended solely for small-pox may serve a larger area than a hospital for other infectious diseases. The modes by which local authorities

may combine for the provision of hospitals are set forth in an office memorandum on "Isolation Hospitals," which may be obtained on application, for the guidance of local authorities desirous of such combination or of establishing hospitals under the sanction of the Local Government Board.

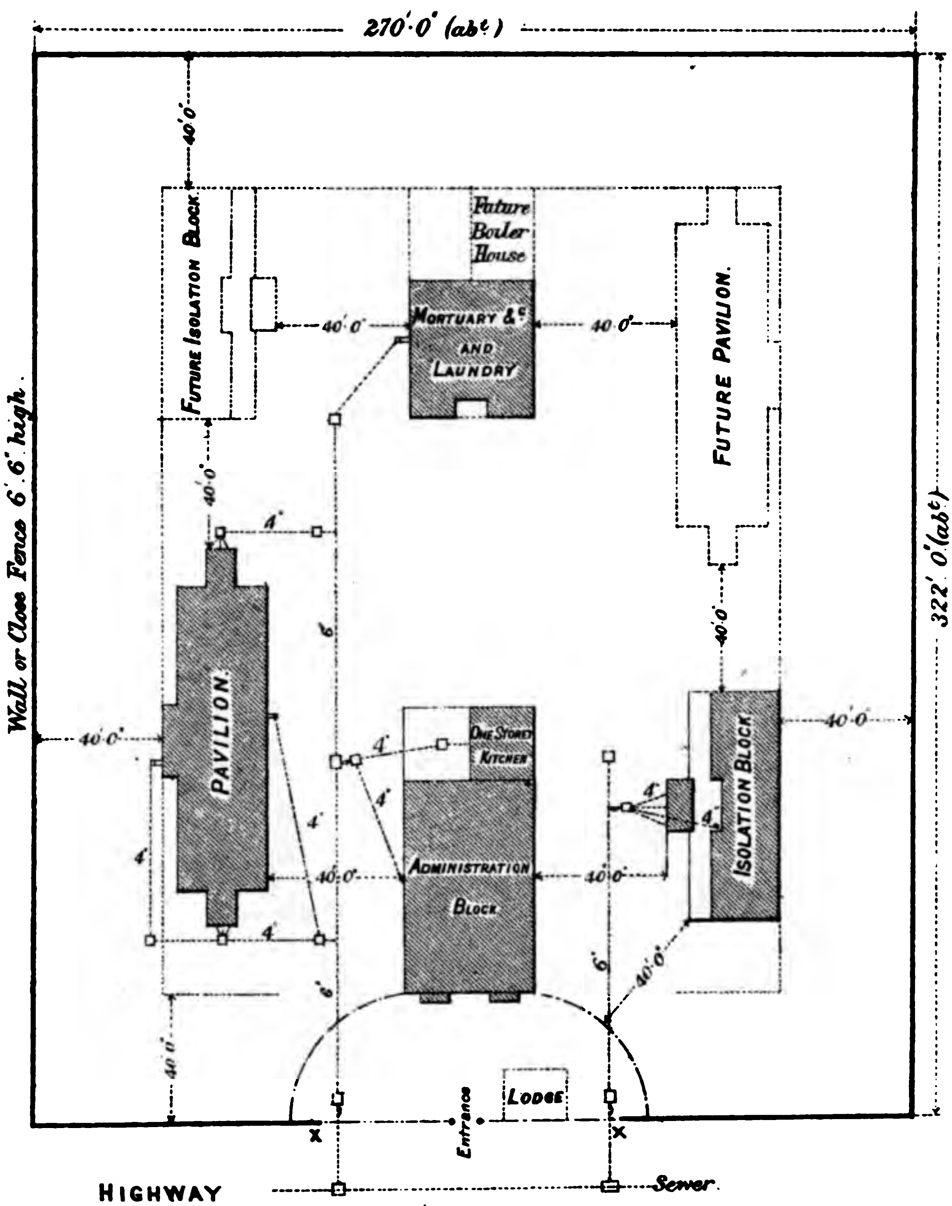
Size of Hospital in proportion to population.—The amount of permanent isolation hospital accommodation which should be provided in proportion to the population will depend upon various considerations, among the most important of which are the character of the district, whether urban or rural; the rate of increase of population; the housing and the habits of the people; and the amount of intercourse with other places from which infectious disease may be introduced. As a rough estimate, one bed for every thousand inhabitants is sometimes adopted, but in view of the diverse circumstances of different districts this cannot be regarded as a definite standard. Moreover, the sufficiency of the hospital accommodation will depend not merely upon the aggregate number of beds, but also upon the way in which they are arranged in wards. In a single block with wards connected together only one disease can safely be treated at a time; and thus, at a hospital containing only one such block, occasions may arise when, owing to the hospital being partly occupied by one disease, a case of a second disease requiring isolation cannot safely be taken in, although there may be a number of beds empty at the time.

It is common to find that the demand for hospital accommodation, when people have come to appreciate the benefits of its use, increases far beyond what was at first anticipated; and for this reason, as well as to allow for growth of the population and for the possible need for temporary extensions during epidemics, it is well at the outset to provide for the contingency of future enlargement.

Site.—In selecting a site for an isolation hospital the following considerations should be had in view:—It should be convenient of access, and, as far as practicable, central for the population and area which it is to serve; but of course not in a very populous neighbourhood. (In the case of hospitals in which small-pox is intended to be received the choice of site must be specially governed by considerations as to the number of inhabitants in the neighbourhood, which will be referred to later on.) It will be of much convenience if sewers and a public water service are available; but, if not, a sufficient supply of wholesome water must be provided, and arrangements will have to be made for the treatment of the sewage by application to land, due care being taken to avoid pollution of any well or spring or of any river. The site should be in a healthy and open situation with a dry subsoil, and should be preferably of a compact and regular shape, and not too steep. Its area will depend upon the size of the hospital, and, except in the case of a very small hospital, should rarely be less than two acres; indeed it is well to obtain a larger site than may at first be required, in order to afford space for subsequent extension if necessary. More land, too, will be needed if the sewage has to be

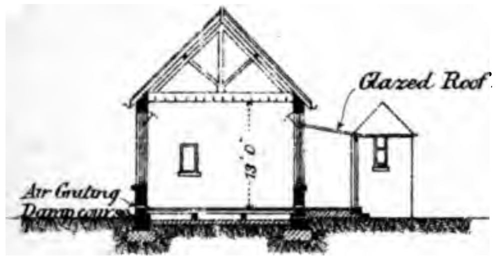
A

BLOCK PLAN.



E. Weller & Grahams, Ltd Litho. London.

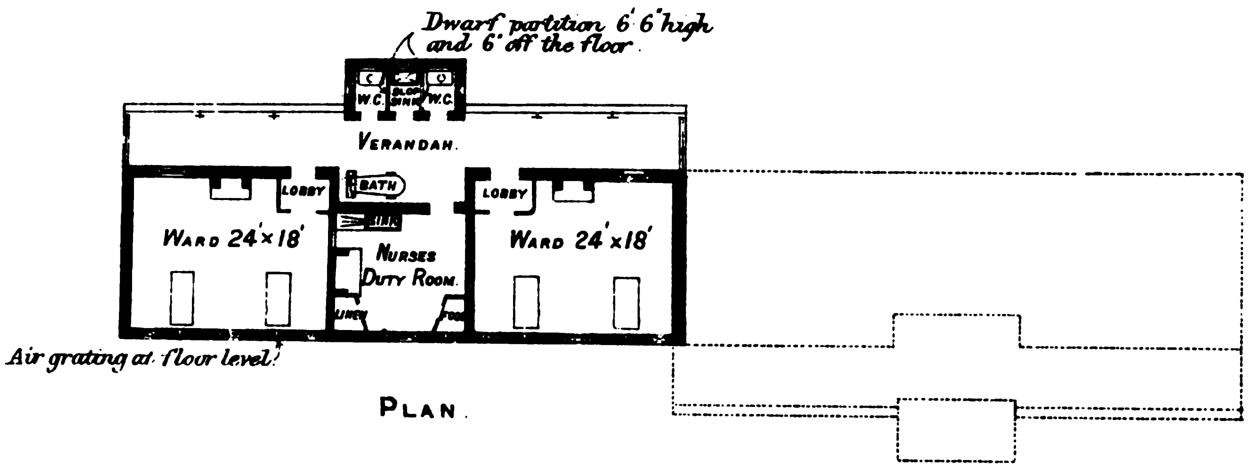
B.



SECTION

NOTES. *In a double block on this pattern the entrances and verandahs should be on alternate sides as here illustrated.*

If the verandahs are enclosed it should be only by a movable screen so arranged that it can be taken away altogether as circumstances require.



PLAN.

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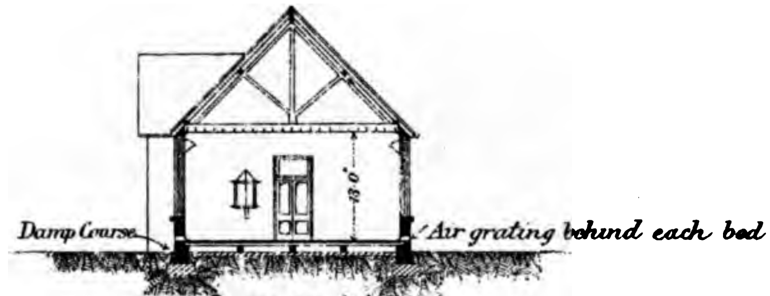
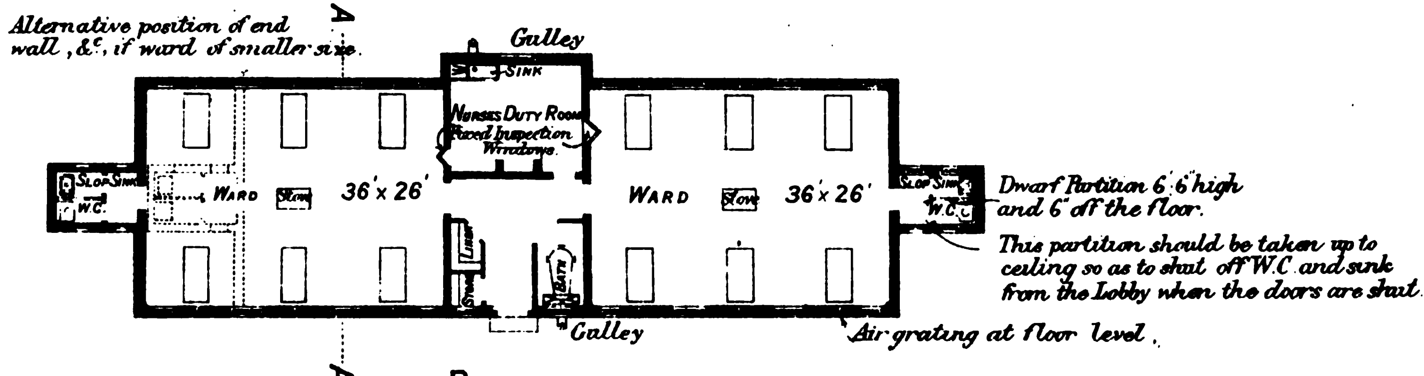
C.



SECTION AA.



PLAN.

E. Weller & Graham. Ltd Litho. London

disposed of on the site. *The site, or so much of it as is to form the grounds of the hospital, should be enclosed by a wall or close fence at least 6 feet 6 inches in height, and every building which is to contain infected persons or things should be at least 40 feet distant from the boundary.**

Hospital buildings.—These should be of three classes, viz.: 1st, ward-blocks for the reception of the sick; 2nd, administration-block for the housing of the staff and stores; and 3rd, out-offices, as laundry and mortuary. In hospitals for permanent use these buildings should be of brick or stone. Temporary buildings, as, for instance, buildings constructed of wood or corrugated iron, are ill suited for permanent use as hospitals, for the reason that it is difficult to maintain them at a proper temperature during extremes of hot and cold weather; moreover they are less durable than brick or stone buildings, requiring more frequent repairs in order to keep them in a properly weather-proof condition, and they are liable to be destroyed by fire and storm. *It is not the practice of the Local Government Board in ordinary cases to sanction loans for iron hospitals or for hospital buildings of temporary character.*

Existing buildings originally designed for a different purpose such as dwelling houses, even when of large size, are rarely found to be well adapted for the reception of patients; especially for the accommodation at one time of patients suffering from different infectious diseases. An existing house, however, may sometimes serve as the administration-block, if it have sufficient land attached on which to erect ward-blocks.

The *administration-block*, which should be kept free from patients and infected articles, should be so placed as to control the entrance to the hospital grounds, unless a porter's lodge is intended to be erected. It should contain quarters for the matron or caretaker, and a sufficient number of bed-rooms for the nurses and servants who will be required to work the hospital when in full operation; also a nurse's sitting room; a kitchen (preferably in a one-storey projection with top ventilation), store-rooms, dispensary, &c. In hospitals of considerable size quarters for a resident medical officer will also be necessary. It is well to provide in the administration-block accommodation on a scale somewhat in excess of what may be at first required, in order that it may be available for future extensions of the hospital, temporary or permanent; but in any case the block should be so planned that it can be easily enlarged in the future if necessary.

The *ward-blocks* should be one-storey buildings, unless where in exceptional cases or at large hospitals exigencies of space may render it necessary to construct blocks of two storeys; in such case each storey should have a separate entrance from the open

* If desired, an open unclimbable railing may be substituted for a wall or close fence for so much of the boundary as is within supervision and control from the administration block or porter's lodge, as between the points X–X on the annexed block plan A, but in that case a second line of unclimbable fence should be constructed within the first, as indicated on the plan.

APP. A, No. 16.

Memoranda prepared or revised in the Medical Department during 1900.

air. The annexed plans illustrate two different types of ward-block suitable for small or moderate sized hospitals. The type illustrated in plan C is the most advantageous, as regards both cost of construction and convenience of administration, where a number of patients of both sexes suffering from the same disease have to be treated at one time. The number of beds in each ward will vary with the requirements of the district, and it is sometimes found desirable to make one ward rather larger than the other, as indicated on the plan, in order that young children of both sexes may be treated in the women's ward.

Plan B shows a ward-block with small wards separately entered from the open air under a verandah. Accommodation of this kind is useful not only for cases of a second disease, but also under a variety of circumstances, as for the keeping under observation of a case of doubtful nature; for the segregation of a complicated, noisy, or offensive case; or as private wards for paying patients, &c.

For very large hospitals other types of ward may be found of advantage.

In the ward-blocks each bed must have at least 12 *linear feet of wall space,* 144 *square feet of floor space, and* 2,000 *cubic feet of air space.* In calculating the latter any height of wards above 13 feet should not be taken into account. The walls should be of adequate thickness; and the inner face of the walls as well as the floors and woodwork should be constructed with smooth impervious surfaces and rounded angles, so as to facilitate cleanliness and to avoid spaces which may harbour dust and dirt. Ventilation should be by windows on opposite sides of the ward; the windows should be double-hung sashes with fanlight above, and the fanlight should be made to fall inwards, hopper-fashion, with side cheeks to prevent down draughts. The area of the windows should be sufficient but not excessive; one square foot of window to every 70 cubic feet of ward space is a suitable proportion. The best aspect for the ward-blocks is usually with the windows facing respectively south-east and north-west. The wards should have adequate means of warming, which may with advantage be so contrived as to furnish a supply of warm fresh air. An ample supply of hot water for baths should be provided, and bath-rooms should be capable of being warmed. The closets and slop-sinks should be placed in annexes separated from the wards by cross-ventilated lobbies. The closets should be water-closets where practicable; and the slop-sinks should be of an appropriate pattern adapted to receive the solid and liquid contents of bed-pans, the waste-pipe being 3 inches in diameter and arranged similarly to the soil-pipe of a water-closet.

The *out-offices* will comprise such buildings as laundry, disinfecting-chamber, mortuary, and ambulance-shed; and in large establishments a boiler-house and engine-house may be needed. Except in very small hospitals, the laundry should comprise a wash-house, a drying-closet, and an ironing room. An apparatus should be provided for the disinfection by steam of bedding and articles which cannot be washed. The mortuary

should be in a cool and unobtrusive position, and should be lighted from the north only.

A discharging-block is not unfrequently provided, consisting of an undressing-room, a bath-room, and a dressing-room, in which convalescents may take their final bath and put on clean clothes before leaving the hospital.

Each building which is to contain infected persons or things should be at least 40 feet distant from any of the other buildings.

The drains of each block should be trapped from the common drain and ventilated separately by an inlet just above the trap and by ventilating shafts at their highest points.

The annexed block plan A illustrates the arrangement upon a rectangular site of about two acres of a hospital containing 16 beds, in two ward blocks with administration-block and out-offices; space being also reserved for future extensions. The best arrangement of the buildings will, however, in practice largely depend upon the shape and contour of the site.

If, owing to the bleakness of the site, it is considered desirable that the several blocks should be connected by covered ways, these should not be enclosed, but should be open at the sides. A screen for protection against wind and driving rain may be provided if desired.

Hospitals for small-pox.—In view of the frequently demonstrated liability of small-pox hospitals to disseminate that disease to neighbouring communities, and in order to lessen the risk of such occurrence, the Board require the following conditions to be complied with in the case of small-pox hospitals provided by means of loans sanctioned by them :—

1st. *The site must not have within a quarter of a mile of it either a hospital, whether for infectious diseases or not, or a workhouse, asylum, or any similar establishment, or a population of as many as 200 persons.*

2nd. *The site must not have within half a mile of it a population of as many as 600 persons, whether in one or more institutions, or in dwelling-houses.*

3rd. *Even where the above conditions are fulfilled, a hospital must not be used at one and the same time for the reception of cases of small-pox and of any other class of disease.*

Useful information on the administration of isolation hospitals, derived from experience of them in various parts of England and Wales, will be found in a report [C.—3290] of the Medical Department, 1882—re-issued in 1894.

W. H. POWER,
Medical Officer.

Local Government Board,
Medical Department,
August, 1900.

(2.)

PLAGUE MEMORANDUM.

(1.) *Administrative Considerations.*

Plague having for the space of nearly two centuries receded from Europe, has in recent years once more trended westward, and has now again appeared in Great Britain. Sanitary Authorities of England and Wales will therefore need to be on the alert to detect the presence of this disease in their districts, with a view to prevent its becoming epidemic among their populations.

It is to be anticipated, from the behaviour thus far of the recent western extension of the disease, that plague will not readily fasten on that section of our population which is properly housed, cleanly, and generally, in a sanitary sense, well to do; that rather it will especially affect, if it obtains foothold in one and another district, insanitary areas such as are peopled by the poorest class, and where overcrowding of persons in houses and dirt and squalor of dwellings and of inhabitants tend to prevail.

In these circumstances the following facts respecting plague deserve to be borne in mind :—

(1.) Plague has an incubation period of 3 to 5 (in exceptional cases of perhaps 8 to 10) days.

(2.) Plague is wont, especially in its earlier manifestations, to assume a mild form, or even to present anomalous symptoms, tending to confound it with other and more innocent diseases.

(3.) Plague in all its forms must needs be regarded as personally infective.

(4.) Plague affects rats as well as the human subject; it may, indeed, be found causing mortality among these lower animals antecedent to its definite invasion of the population. There can be no doubt that the rat and man are, as regards plague, reciprocally infective.

Although local authorities should be on their guard against plague, it is not intended to suggest that there exists any cause for alarm. There can be no doubt that, in this country, hygienic conditions and methods of dealing with infectious diseases are far in advance of those of former centuries wherein plague was repeatedly epidemic in our populations; they are in advance too, as we believe, of those in localities abroad where plague has shown itself formidable in recent years. And in so far as, in our districts, these conditions and methods are now satisfactory and sufficient, there is the less likelihood of spread of infection from plague cases casually imported. During the past 50 years there has occurred in England and Wales a large diminution in the mortality from most diseases of the infectious class, and in the same period typhus fever has declined almost to extinction. This latter disease is that which, as regards the conditions under which it becomes prevalent, most closely resembles plague. Wherefore

it may be confidently anticipated that the measures of sanitary improvement, of isolation and of disinfection, which have been found effectual against indigenous disease such as typhus will, if promptly and thoroughly brought to bear, be equally effectual against plague.

First among measures requisite for control of plague is prompt information to the local authority of all cases of the disease occurring in their district. The Board, therefore, have issued an Order requiring, under penalty, immediate notification to the Medical Officer of Health of the district, and by him to the Board, of every recognised case of plague. Meanwhile, and in order to help towards recognition of this disease in its obscurer manifestations, a statement of the clinical features exhibited by this malady will be found in Part (2) of this Memorandum. Further, and with a view to assisting in the identification of plague newly developing in one and another district, the Board have arranged for bacteriological testing, without cost to the local authority, of material submitted to their Medical Officer by the Medical Officer of Health from the earliest suspected case or cases.*

In the event of plague being detected in any district, the measures to be taken to prevent its spread are, generally speaking, those which are available against the more ordinary epidemic diseases of this country, as set forth in the accompanying "General Memorandum." These measures include prompt removal of the sick persons to hospital and their isolation therein; the destruction or thorough disinfection of all infected articles, with the effectual disinfection also of the invaded dwelling place; the keeping under observation during 10 days after detection of each plague case all persons who have been in contact with the patient, and house to house visitation for the discovery of unreported or suspicious cases; the abatement as speedily as possible of all insanitary conditions in the locality which may tend to the spread of the disease; and, in the case of death, the prompt disposal of the corpse, with all due precautions against its becoming a source of infection.

An essential measure of precaution in view of the observed relation between plague in rats and plague in the human subject, will be the prompt destruction of all rats in districts threatened or invaded by plague, care being taken that their carcases are collected and burnt without being unduly handled.

It is to be noted that when treated in a well appointed hospital, with plentiful fresh air and proper attention to cleanliness and disinfection, plague, except in its pneumonic and septicæmic forms, shows but small infective power; and that therefore doctors and nurses in attendance on the sick run but little risk of contracting the disease. Nevertheless, these and other persons brought into close relation with plague, may be afforded protection against infection by submitting themselves to protective inoculation of the sort practised with advantage to the inhabitants of

* Directions for collecting and forwarding suspected material are issued by the Local Government Board to Medical Officers of Health.

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invaded areas by Professor Haffkine, under the auspices of the Indian Government, in Bombay. As yet the protective material in question is not generally purchaseable in this country. For the present, therefore, and until further notice, the Board, having provided themselves with a supply of Professor Haffkine's plague prophylactic, will be prepared to issue this material in limited amount to the Medical Officers of Health of districts actually invaded by plague, for the protection therein of doctors, nurses, and other persons that are, under the conditions of the invaded area, being subjected to sustained exposure to plague infection.

(2.) *Symptoms of Plague.*

An ordinary attack of Plague usually begins some three to five days after exposure to infection. Such attack may develop gradually, but, as commonly met with, there is sudden onset with much fever, as indicated by a high temperature, rapid pulse, headache, hot skin, and thirst. The eyes are injected as if inflamed; the expression, at first anxious and frightened, becomes subsequently vacant and dull; the utterance is thick, and the gait unsteady as in one under the influence of drink. There is at times a distinct tendency to faint. The tongue is at first covered with a moist white fur except at the edges, which are red, but later on it becomes dry and of a mahogany colour.

The most distinctive sign of plague is the presence of swellings, or "buboes" as they are called, in the groin, armpit, or neck. These "buboes," which led to the disease being called "bubonic plague" and which have no relation to venereal complaints, appear as a rule about the second or third day of the disease. They are usually painful and tender on pressure, and in size they vary from that of an almond to that of an orange. Later on they may "gather" and burst like an ordinary abscess. There may, too, appear about the body purple spots, and what are known as "carbuncles."

But buboes are not an essential feature of plague. Cases occur in which these manifestations of the disease are greatly delayed or even absent, as for instance in "Pneumonic," "Gastric," and "Septicæmic" plague; forms of the malady which may be mistaken for respectively inflammation of the lungs, typhoid fever, and acute blood poisoning. Plague in these forms is always grave; not only because of the fatality of the cases, but for the reason that they, especially the "pneumonic," are highly infectious to other persons. It is important, therefore, that in localities where plague is present or is threatened, cases of anomalous illness of the above sorts be without loss of time brought under medical supervision.

Besides the forms of plague already referred to there is yet another, namely the so-called "ambulant" form. In plague of this description the affected person is hardly ill at all, presenting no definite symptoms perhaps beyond indolent, though painful, swellings in groin or armpit. Such plague cases may nevertheless be instrumental in spreading the disease, and any persons there-

fore who, having been possibly exposed to plague, exhibit these symptoms, should be isolated and watched medically until the nature of their malady has been definitely ascertained.

W. H. Power,
Medical Officer.

Local Government Board,
Medical Department,
September, 1900.

(3.)

Directions for the Use of the Haffkine Plague Prophylactic.

This prophylactic material is harmless, and can be left about without danger. But, once opened, the contents of a flask are easily contaminated, and prolonged exposure of the flask to daylight is to be avoided. When kept in sealed-up flasks in a dark and sufficiently cool place, the material is likely to retain its power indefinitely.

2. The prophylactic is to be given by hypodermic injection. For this purpose an ordinary Pravaz syringe (with the piston in leather) may be employed. Before use this syringe should be disinfected by keeping it filled with a five per cent. solution of carbolic acid for at least one hour, and washed out afterwards with water, previously boiled for ten minutes and cooled down again. Alternatively, a Pasteur syringe (such as is used for antitoxic serum, having a piston in india-rubber) may be employed. It should first be disinfected by boiling for ten minutes in water. In either case the needle of the syringe should be kept sterile by wrapping it up in a wet cotton pad soaked with carbolic solution.

3. Each flask before being opened is to be shaken, so that its contents may become well mixed.

4. For an adult male in average health, about five to six cubic centimetres (15 minims counting for one cubic centimetre) is the dose. This should be preferably injected under the skin of the left arm. For a woman the dose is four to five cubic centimetres, that is, it is slightly less than for a man; and for a child the amount varies according to age, the rule being to give one twenty-fifth of an adult dose for each year of the child's age. Infants may be inoculated without harm. The dose will vary according to the estimated standard strength of the particular sample in the flask (the strength of each sample and adult dose is marked upon the flask).

5. Before proceeding to inoculate, the surface of the arm should be cleansed by means of a pad of lint or cotton wool soaked in a five per cent. solution of carbolic acid, or in other suitable disinfectant solution. The patient should be made to sit down before the inoculation is made. No special dressing is necessary over the puncture, but it may be covered with a pad of sterilized

cotton wool or boric lint. The arm should be kept at rest. No changes in diet or occupation are necessary.

6. The inoculation should induce "reaction" as follows:—Some smarting is felt immediately after the inoculation, and in a few hours there is redness at the seat of the injection, with more or less swelling and some tenderness. There is also some pain on movement. In from 10 to 15 hours this decreases, though it does not altogether disappear for five or more days. The "reaction" is further shown by a rise of temperature which, in the majority of instances, does not exceed 102° F., and lasts for about 24 hours. Nervous individuals sometimes show a tendency to faint. Caution must be exercised in persons suffering from heart affections, and in those who have chronic diarrhœa or the like. For such persons the dose should be reduced by one half, and repeated on two occasions, at intervals of three to five days. With these reservations, it may be said that anyone can be safely inoculated. The protection is regarded as established as soon as the general symptoms of reaction have developed. Failure to produce in a series of cases inoculated with a given sample of the material, reaction marked by the rise of temperature referred to, point to the prophylactic having deteriorated. In such case the operation should be repeated with a larger dose of the same material, or, better still, with a fresh sample from another flask.

7. It is requested that a detailed account of all operations done with this prophylactic, and of all collected observations, be communicated to the Medical Officer, Local Government Board, Whitehall, London, S.W.

W. H. POWER,
Medical Officer.

Local Government Board,
Medical Department,
September, 1900.

(4.)

DIRECTIONS for OBTAINING and FORWARDING for BACTERIOSCOPIC EXAMINATION MATERIAL from SUSPECTED PLAGUE CASES.

[*The Local Government Board, with a view to assisting in the identification of plague newly developing in one and another district, have arranged for bacteriological testing, without cost to the local authority, of material from the earliest suspected case or cases in the district. This material can be received only from the Medical Officer of Health.*]

A.—*From the Living Person.*

1. Clean with soap and water and then with alcohol the last phalanx of either the second or third finger. When dry, or after

mopping with a clean cloth, put a piece of tape round the proximal end of the last phalanx so as to cause venous congestion. Prick the palmar surface of this phalanx with a sterile needle, and immediately take up the exuding blood in two sterile capillary tubes such as are used for collecting vaccine lymph. These tubes when charged should be sealed at both ends.

2. When there is a discharging bubo, collect fluid therefrom in capillary tubes as in the case of blood. When this discharge is not of a sufficiently fluid character for collection in this way, place some of it in a small glass-stoppered phial, previously well washed out with alcohol, care being taken that no alcohol remains in the phial.

3. If expectoration be obtainable, collect some in a phial in the manner prescribed in section 2.

B.—*From the Dead Body.*

1. Cut out any inflamed lymph gland, together with some of its surrounding tissue, and place the whole in a wide-mouthed glass-stoppered bottle, previously well washed out with alcohol, care being taken that no alcohol remains in the bottle. The bottle should have the stopper well secured and sealed.

2. Obtain also a piece of the spleen, dealing with it in the same manner.

All suspected plague material should be carefully packed so as to avoid risk of breakage.

It is to be addressed to "The Medical Officer, Local Government Board, Whitehall, London."

Full particulars as to source should in each instance accompany the material forwarded.

W. H. POWER,
Medical Officer.

Local Government Board,
Medical Department,
September, 1900.

(5.)

GENERAL MEMORANDUM on the PROCEEDINGS which are advisable in PLACES ATTACKED OR THREATENED by EPIDEMIC DISEASE.

1. Wherever there is prevalence or threatening of cholera, diphtheria, fever, or any other epidemic disease, it is of more than common importance that the statutory powers conferred upon Local Authorities for the protection of the public health should be well exercised by those Authorities, acting with the advice of their Medical Officers of Health.

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Memoranda prepared or revised in the Medical Department during 1900.

2. Proper precautions are equally requisite for all classes of society. But it is chiefly with regard to the poorer population, resident in the courts and alleys of towns and in the labourers' cottages of country districts, that Local Authorities are called upon to exercise vigilance, and to proffer information and advice. Common lodging-houses, and houses which are sub-let in several small holdings, always require particular attention.

3. Wherever there is accumulation, stink, or soakage of house refuse, or of other decaying animal or vegetable matter, the nuisance should as promptly as possible be abated, and precaution should be taken not to let it recur. Especially examination should be made as to the efficient working of sewers and drains, and any defect therein, and any nuisance therefrom or from any foul ditches or ponds, should be got rid of without delay. The ventilation of sewers, the ventilation and trapping of house drains, and the disconnexion of cistern overflows and sink pipes from drains should be carefully seen to. The scavenging of the district, the cleanliness of the surface of the ground, and the state of receptacles for excrement and of ash-pits or dust-bins, will require close attention. In slaughter-houses, and wherever animals are kept, strict cleanliness should be enforced.

4. In the removal of filth during periods of epidemic disease, it is commonly necessary to employ chemical agents—*e.g.*, green copperas, or chlorinated lime—for reducing or removing the offence and harm which may be involved in the disturbance of the filth. In the removal of privy contents these agents are more particularly wanted if the disease in question be cholera or enteric fever. The chemical agent should be used liberally over all exposed surfaces from which filth has been removed. Unpaved earth close to dwellings, if it be sodden with slops or filth, ought to be treated in the same way.

5. Sources of water-supply should be well examined. Water from sources which can be in any way tainted by animal or vegetable refuse, especially those into which there may be any leakage from sewers, drains, cesspools, or foul ditches ought no longer to be drunk. Above all, where the disease is cholera, diarrhœa, or enteric fever, it is essential that no impure water be drunk.

> The liability of leaky water-pipes to act as land drains and to receive foul matters as well as land drainage through their leaks is not to be overlooked. And such leaky pipes, running full of water with considerable velocity are liable to receive, by lateral insuction at their points of leakage, external matters that may be dangerous. This latter fact is not recognised so generally as it should be; and ignorance of it has probably baffled many inquiries in cases where water services have in truth been the means of spreading disease.

If, unfortunately, the only water which can be got should be open to suspicion of dangerous organic impurity, it ought at least to be boiled before it is used for drinking. It should not be drunk later than 24 hours after it has been boiled. Filtering of the ordinary kind cannot of itself be trusted to purify water. It

cannot be too distinctly understood that dangerous qualities of water are not obviated by the addition of wine or spirits.

6. When there appears any probable relation between the distribution of disease and of milk supplies, the cleanliness of dairies, the purity of the water used in them, the health of the persons employed about them, and the health of the cows that furnish milk should always be carefully investigated. Even apart from any apprehension of milk being concerned in a particular outbreak of disease, it is desirable that English people should adopt the custom, which is always followed in some continental countries, of boiling all milk at once upon its reception into a house, unless, indeed, such milk has been previously sterilised.

7. The washing and lime-whiting of uncleanly premises, especially of such as are densely occupied, should be pressed with all practicable despatch.

8. Overcrowding should be prevented. Especially where disease has begun, the sick-room should, as far as possible, be free from persons who are not of use to the patient.

Ample ventilation should be enforced. It should be seen that windows are made to open, and that they are sufficiently opened. Especially where any kind of infective fever has begun, it is essential, both for patients and for persons who are about them, that the sick-room and the sick-house be constantly traversed by streams of fresh air.

9. The cleanliest domestic habits should be enjoined. Refuse matters should be speedily removed or destroyed; and things which have to be disinfected or cleansed should always be disinfected or cleansed without delay. The influence of exposure tc sunlight and fresh air in the destruction of infection should be borne in mind.

10. Special precautions of cleanliness and disinfection are necessary with regard to infective matters discharged from the bodies of the sick. Among discharges which it is proper to treat as infective are those which come in cases of small-pox and scarlatina from the affected skin; in cases of cholera and enteric fever from the intestinal canal; in enteric fever also the urine; in cases of diphtheria and scarlatina from the nose and throat; likewise, in cases of any eruptive or other epidemic fever, the general exhalations of the sick. The caution which is necessary with regard to such matters must, of course, extend to whatever is imbued with them; care must be taken that bedding, clothing, towels, handerchiefs, and other articles which have been in use by the sick may not become sources of mischief, either in the house to which they belong or in houses to which they are conveyed. So far as articles of this class can be replaced by rags or things of small value, it is best to use such things and burn them when they are soiled. Otherwise clothing and infected articles should be subjected to the disinfectant of the sick room before washing, or be removed for disinfection by steam heat.

In enteric fever and cholera the evacuations should be regarded as capable of communicating an infectious quality to any nightsoil

with which they are mingled in privies; drains, or cesspools; and after such disinfection of them as is practicable, they should be disposed of without delay and under the safest conditions that local circumstances permit. They should not be thrown into any fixed privy receptacle, and above all, they must never be cast where they can run or soak into sources of drinking water.

11. All reasonable care should be taken not to allow infective disease to spread by the unnecessary association of sick with healthy persons. This care is requisite, not only with regard to the sick house, but likewise with regard to schools and other establishments wherein members of many different households are accustomed to meet.

12. If disease begins in houses where the sick person cannot be properly accommodated and tended, medical advice should be taken as to the propriety of removing him to an infirmary or hospital. Every Local Authority should have in readiness a hospital for the reception of such cases.

Where dangerous conditions of residence cannot be promptly remedied, it will be best that the inmates, while unattacked by disease, remove to some safer lodging.

Persons who have been in association with the sick should be kept under observation for a time corresponding to the longest known period of incubation of the disease in question.

13. In the event of death taking place from an infectious disease, the body should as soon as possible be placed in a coffin with chlorinated lime or other suitable disinfectant, and should be buried (or cremated) with no longer delay than is necessary to allow the fact of death to be verified. Holding of "wakes," large funeral assemblages, and exposure of the corpse to visitors, are especially to be avoided, as is also borrowing of mourning dress for the occasion of the funeral.

14. Privation, as predisposing to disease, may require special measures of relief.

15. In certain cases special medical arrangements are necessary. For instance, as cases of cholera in this country sometimes begin somewhat gradually in the comparatively tractable form of what is called "premonitory diarrhœa," it is essential that, where cholera has appeared, arrangements should be made for affording medical relief without delay to persons attacked, even slightly, with looseness of bowels. So, again, where small-pox is the prevailing disease, it is essential that all unvaccinated persons (unless they previously have had small-pox) should very promptly be vaccinated; and that re-vaccination should be performed in cases properly requiring it.

16. It is always to be desired that the people should, as far as possible, know what real precautions they can take against the disease which threatens them, what vigilance is needful with regard to its early symptoms, and what (if any) special arrangements have been made for giving medical assistance within the district. For the purpose of such information, printed hand-bills or

placards may usefully be employed, and in cases where danger is great, house-to-house visitation by discreet and competent persons may be of the utmost service, both in quieting unreasonable alarm and in leading or assisting the less educated and the destitute parts of the population to do what is needful for safety; as well as in the discovery of unreported or suspicious cases of illness.

17. The present memorandum relates to occasions of emergency. Therefore the measures suggested in it are essentially of an extemporaneous kind; and permanent provisions for securing the public health have, in express terms, been but little insisted on. It is to be remembered, however, that in proportion as a district is habitually well cared for by its Local Authority, the more formidable emergencies of epidemic disease are not likely to arise in it.

18. Provision by the Local Authority for disinfection by steam of bulky articles, and of those which cannot without injury be boiled in water or exposed to chemical agencies, ought always to be in readiness. Without such provision no complete disinfection of such articles can be effected. Partial and nominal disinfection, besides being wasteful, may be mischievous, as giving rise to a false security.

19. The following system of domestic disinfection may be commended to Local Authorities who have already provided adequate public means for the disinfection and for the disposal of infected matters and things:—

(*a.*) For the purposes of the sick room such as the reception of soiled handkerchiefs, sheets, and the like, as well as for the swabbing of floors, a valuable disinfecting solution may be made with perchloride of mercury. It is well to have this solution slightly acid, coloured also in such a way that it shall not readily be confused with drinks or medicines; and proper caution should be given to avoid accidents in its use. Local Authorities will find it advantageous to have such a solution* prepared and issued under the direct instructions of the Medical Officer of Health, and supplied of

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* Solutions fitted for the desired purposes are:—

(1) ½ oz. corrosive sublimate, 1 fluid oz. hydrochloric acid, and five grains of commercial aniline blue, in three gallons (a bucketful) of common water. It ought not to cost more than 3*d.* the bucketful, and should not be further diluted. The use of non-metallic vessels (wooden or earthenware house tubs or buckets) should be enjoined on those who receive it, and articles that have been soaked in it should be set to soak in common water for some hours before they go to the wash.

(2) Chlorinated lime (bleaching powder) in water, of the strength of one part in 100 = 1 lb. to 10 gallons of water.

(3) Formalin—a solution of formic aldehyde gas in water. This may be used diluted in the proportion of 1 part of formalin to 50 parts of water. It is more expensive than the two preceding solutions, but has the advantage of being less corrosive, and less likely to injure articles with which it comes in contact.

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a uniform strength at the infected house upon the order of that officer. After being steeped in such solution and rinsed linen and other washable articles should be washed in boiling water.

(*b.*) In places provided with proper systems of excrement disposal, excrements of cholera and enteric fever, after being treated in detail with the same disinfecting solution in ample quantity, may be safely put into the ordinary closet: but special care as to the flushing of drains and sewers, and special frequency in the removal and exchange of excrement receptacles, will commonly be wanted. Where the only closet is one that communicates with a cesspool or privy pit, the best arrangement for the disposal of infected stools that under these improper local circumstances may be found practicable will have to be adopted, *e.g.*, special pails, furnished with tight-fitting lids and painted a distinguishing colour, may be furnished and collected daily by the Local Authority; their contents being then mingled with sawdust and burnt in a furnace.

(*c.*) The interiors of infected rooms should be disinfected by skilled persons acting under the directions of the Medical Officer of Health. The room should be prepared by the removal of such articles as are best disinfected by heat, and of bright metallic objects which would be tarnished; and, where gaseous disinfection is to be employed, by the closing up of all openings and crevices. The gas most frequently employed in the past for the purpose of room-disinfection has been sulphurous acid gas, obtained by burning sulphur, or liberated from cylinders in which it had been compressed for the purpose; but recent experiments tend to show that the disinfecting power of this agent has been over-rated, and that chlorine gas, which may be obtained by pouring sulphuric or hydrochloric acid upon chlorinated lime, and formic aldehyde gas evolved by means of a special lamp, are more efficacious disinfectants. But, inasmuch as the infection which has to be destroyed is not that in the air of the room, but that clinging as dust and dirt to the surface and recesses of walls, floors, ceiling, and furniture, the use of these gaseous disinfectants may, with advantage, be replaced by the spraying upon the surfaces to be disinfected of a liquid disinfectant such as one or other of the solutions mentioned in the note to paragraph (*a.*)

(*d.*) After measures of disinfecting a room have been taken the wall paper (especially if soiled, torn or loose) should be stripped from the walls and be burned, and the room should have its ceilings and walls thoroughly washed or lime whited. The floor and woodwork should also be well washed with soap and water.

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20. For detailed information on disinfection by heat, on hospital accommodation, on small-pox, and on questions of school administration during the prevalence of infectious disease, *see* the Office Memoranda and Reports on these subjects.

W. H. Power,
Medical Officer.

Local Government Board,
Medical Department,
September, 1900.

(6.)

MEMORANDUM as to ANNUAL REPORTS of MEDICAL OFFICERS OF HEALTH (LONDON).

Every medical officer of health in London, appointed under Order of the Local Government Board, is required to make an annual report with regard to each sanitary district, or division of a district, which is under his superintendence. This report is to be for the year ending the 31st of December, or, if the officer at that date has not been in office for a whole year, then for so much of the year as has elapsed since his appointment. The report is to be made to the Borough Council, and the medical officer of health himself should send a copy of it to the Local Government Board and to the London County Council.* It should be made as soon as practicable after the expiration of the year to which it relates, and should be in the hands both of the Borough Council and of the Board, within, at most, five months from the end of the year. The Board's copy of the report should be forwarded to them when the original is sent to the Borough Council, except where the report is likely to be printed by order of the Borough Council. In such cases the Board need only be supplied with a printed copy. It is very desirable that the annual report should be printed, for the sake of facility of reference and in order that a supply of copies may be available for distribution among the borough councillors and other persons interested.

Article 18 (Section 15) of the Board's Order of 8th December 1891, specifies the information to be contained in the annual report, and is annexed.

The report should be chiefly concerned with the conditions affecting health in the district and with the means for improving

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* Where the district for which a medical officer of health acted at the beginning of the year has, in consequence of the London Government Act, 1899, or of any Order made thereunder, been placed under the jurisdiction of two or more Borough Councils, the medical officer of health should send to each Borough Council, either a report on the whole area for which he has acted during the previous year, or a report relating to so much of that area as on the 31st December of that year was under the jurisdiction of each such Borough Council. If one report only be made, the medical officer of health should make such distinctions as will enable each Borough Council to ascertain the facts specially relating to its own district.

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those conditions. It should contain an account, brought up to the end of the year under review, of the sanitary circumstances of the district, and of any improvement or deterioration which may have occurred during the year in these circumstances. Care should be taken to report fully and explicitly on the influences affecting or threatening to affect injuriously the public health in the district, and on the action which has been taken, or which may still be needed, with a view to combat those influences. It is of especial importance that the medical officer of health should record what action has been taken to remedy unhealthy conditions which have been reported by him in previous annual reports, or in special reports presented during the year under review, and that attention should be called afresh, year by year, to such as remain unremedied.

As subject matters concerning which the Board desire to obtain, through annual reports of the medical officer of health, not only definite general information but record also of particular changes of condition that are occurring incidentally or by action of the local authority, the following deserve to be especially borne in mind :—

General features of the district, and conditions of its population.

House accommodation, especially for the working class; its adequacy and fitness for habitation. Sufficiency of open space about houses and cleanliness of surroundings. Unhealthy areas. Overcrowding.

Condition of sewers and house drains.

Removal and disposal of house refuse—whether by local authority or contractors ; frequency and method.

Water supply of the district or its several parts.

Conditions under which slaughter-houses, bakehouses, dairies, cowsheds and milkshops, factories and workshops, and offensive trades are carried on.

Nuisances : proceedings for their abatement—any remaining unabated.

Methods of dealing with infectious diseases : notification ; isolation in hospital ; disinfection ; temporary shelters : mortuaries.

With regard to such points it should be remembered that these reports are for the information of the Board as well as of the Borough Council, and that a statement of the local circumstances and a history of local sanitary questions, which may seem superfluous for the latter, may often be needed by the former.

The medical officer of health, in reporting his proceedings and advice, should put on record whether he has made systematic inspections of his district. By "systematic inspections" are meant inspections independent of such inquiries as the medical officer of health may have had to make into particular outbreaks of disease, or into unwholesome conditions to which his attention

has been specially called by complaints or otherwise, and such inspections will include the house-to-house inspections which may be necessary in particular localities.

In making systematic inspections, as in much of his other action, the medical officer of health will usually have required the assistance of the sanitary inspectors; and the medical officer should include in his report an account of the action which, at his instance, the inspectors may have taken for the removal of nuisances injurious to health.

The report should deal with the extent, distribution, and causes of disease, especially of epidemic and notifiable diseases, within the district; and should give an account of any noteworthy outbreaks which may have engaged the attention of the medical officer of health during the year under review, stating the result of his investigations into their origin and propagation, and the steps taken by him or on his advice with a view to check their spread.

The tabular statements of sickness and mortality in the district during the year, to be made on the forms supplied for the purpose, should be the subject of comment in the text of the report, in so far as deductions from them may assist the Board and the Councils concerned to an appreciation of the lines of action needful in the future.

It will be observed that the forms for record of statistical data supplied on the present occasion differ from those supplied in former years. Four tables have, at the suggestion of the Incorporated Society of Medical Officers of Health, been substituted for Tables A and B previously in use. This has been done with a view to facilitate record of a minimum amount of statistical information of the sort desired by the Board.

As regards these several tables a few observations appear to be needful:

In Table I should be stated, for the whole district under the superintendence of a medical officer of health, the number and rates of births, of deaths under one year and at all ages, and the data on which the nett death-rate is based. Spaces are given for the insertion of the corresponding figures for the ten previous years for the sake of comparison, a comparison which will often yield points of interest. In most cases there should be no difficulty in obtaining the figures for former years from previous annual reports, but if owing to changes in the constitution of the district or for other reasons the figures cannot be ascertained for ten years, they should be given for as far back as they are available.

In Table II the births, and the deaths corrected by the exclusion of those of non-residents and the inclusion of those of residents dying elsewhere, are to be distributed among the localities to which they belong, space being given in this table also for the insertion of the corresponding figures in previous years. As regards the classification by localities, it is to be observed that the

district under the superintendence of a medical officer of health may contain several parts evidently differing in their circumstances, or having very different rates of mortality, either from all causes, or from some particular disease or class of diseases. The observation of these differences can scarcely fail to lead to valuable information, especially when the returns for several years can be compared together, and it is in view of such differences that the tabular statements are required in Article 18 (Section 15) to be classified according to "*localities*," and that provision for such a classification is made in the forms supplied for returns of deaths. In the absence of any obvious differences of the above sort, it will still be desirable, unless the district is very small and has no recognized sub-divisions, to classify the deaths according to the part of the district in which they occur; and, for this purpose any areas of known population (such as wards, parishes or groups of parishes, or registration sub-districts) may be taken as representing "*localities*" for the purposes of the Order.

Table III provides for the number of notified cases of infectious disease during the year, classified according to ages of patients and localities, and also the number of cases removed to hospital from each locality. As regards the classification according to locality, the same considerations apply to the record of sickness as to those of deaths.

Table IV provides for the deaths during the year from various causes, classified according to ages and localities. In populous districts a more extended table in a similar form containing a more complete classification of causes of death may with advantage be substituted for this form.

Great care should be taken to note carefully the headings and footnotes before proceeding to fill the columns and the blank spaces in these tables.

What has been said above with regard to the information which an annual report should contain must be understood, not as suggesting that the report should be limited to these subjects, but as indicating the sort of information required by the Board's Order. Many medical officers of health will doubtless, with great advantage to the administration of their districts, furnish much more detailed information and statistics respecting particular questions to which they have been led by the circumstances of the foregoing year to devote attention, or in the investigation of which they may have arrived at definite conclusions. Any information of this kind will be appreciated by the Local Government Board.

W. H. Power,
Medical Officer.

Local Government Board,
December, 1900.

EXTRACT from the ORDER of the LOCAL GOVERNMENT BOARD.

8th December, 1891.

Duties.

Art. 18. The following shall be the duties of a Medical Officer of Health as regards the District or part of a District for which he is appointed (in this article referred to as "his District"):—

(1.) He shall inform himself as far as practicable respecting all influences affecting or threatening to affect injuriously the public health within his District.

(2.) He shall inquire into and ascertain by such means as are at his disposal the causes, origin, and distribution of diseases within his District, and ascertain to what extent the same have depended on conditions capable of removal or mitigation.

(3.) He shall, by inspection of his District, both systematically at certain periods and at intervals as occasion may require, keep himself informed of the conditions injurious or dangerous to health existing therein.

(4.) He shall be prepared to advise the Sanitary Authority on all matters affecting the health of his District, and on all sanitary points involved in the action of the Sanitary Authority: and in cases requiring it, he shall certify, for the guidance of the Sanitary Authority or of the Justices, as to any matter in respect of which the Certificate of a Medical Officer of Health or a Medical Practitioner is required as the basis or in aid of sanitary action.

(5.) He shall advise the Sanitary Authority on any question relating to health, involved in the framing and subsequent working of such bye-laws and regulations as they may have power to make.

(6.) On receiving information of the outbreak of any dangerous infectious disease within his District, he shall visit without delay the spot where the outbreak has occurred, and inquire into the causes and circumstances of such outbreak, and in case he is not satisfied that all due precautions are being taken he shall advise the persons competent to act as to the measures which may appear to him to be required to prevent the extension of the disease, and shall take such measures for the prevention of disease as he is legally authorised to take under any Statute in force in the District, or by any Resolution of the Sanitary Authority.

(7.) Subject to the instructions of the Sanitary Authority he shall direct or superintend the work of the Sanitary Inspector or Sanitary Inspectors in the way and to the extent that the Sanitary Authority shall approve, and on receiving information from any Sanitary Inspector that his intervention is required in connexion with any nuisance, he shall, as early as practicable, take such steps as he is legally authorised to take under any Statute in force in the District, or by any Resolution of the Sanitary Authority, as the circumstances of the case may justify and require.

(8.) In any case in which it may appear to him to be necessary or advisable or in which he shall be so directed by the Sanitary Authority, he shall himself inspect and examine any animal intended for the food of man which is exposed for sale or deposited in any place for the purpose of sale or of preparation for sale, and any article, whether solid or liquid, intended for the food of man, and sold or exposed for sale, or deposited in any place for the purpose of sale or of preparation for sale. If such animal or article appears to him to be diseased, or unsound, or unwholesome, or unfit for the food of man, he shall seize and carry away the same himself or by an assistant in order to have the same dealt with by a Justice according to the provisions of Section 47 of the Public Health (London) Act, 1891.

(9.) He shall perform all the duties imposed upon him by any byelaws and regulations of the Sanitary Authority, duly confirmed where confirmation is legally required, in respect of any matter affecting the public health, and touching which the Sanitary Authority are authorised to frame byelaws and regulations.

(10.) He shall inquire into any offensive process of trade carried on within his District, and report on the appropriate means for the prevention of any nuisance or injury to health therefrom.

(11.) He shall from time to time inspect any Bakehouses which are Workshops, and are situate within his District, and he shall thereupon report to the Sanitary Authority whether any steps are necessary to be taken for the purpose of enforcing, as respects such Bakehouses, the provisions of Sections 34, 35, and 81 of the Factory and Workshop Act, 1878, and Sections 15 and 16 of the Factory and Workshop Act, 1883.

(12.) He shall attend at the office of the Sanitary Authority or at some other appointed place, at such stated times as they may direct.

(13.) He shall from time to time report in writing to the Sanitary Authority his proceedings and the measures which may require to be adopted for the improvement or protection of the public health in his District. He shall in like manner report with respect to the sickness occurring within his District, and the mortality thereof, so far as he is able to ascertain the same.

(14.) He shall keep a book or books, to be provided by the Sanitary Authority, in which he shall make an entry of his visits, and notes of his observations and instructions thereon, and also the date and nature of applications made to him, the date and result of the action taken thereon and of any action taken on previous reports; and shall produce such book or books, whenever required, to the Sanitary Authority.

(15.) He shall also make an annual report to the Sanitary Authority, up to the Thirty-first day of December in each year, comprising a summary of the action taken, or which he has advised the Sanitary Authority to take, during the year for preventing the spread of disease, and an account of the sanitary state of his District generally, at the end of the year. The report shall also contain an account of the inspections and inquiries which he has made as to conditions injurious or dangerous to health existing in his District, and of the proceedings in which he has taken part or advised under any Statute, so far as such proceedings relate to those conditions; and also an account of the supervision exercised by him, or on his advice, for sanitary purposes over places and houses that the Sanitary Authority have power to regulate, with the nature and results of any proceedings which may have been so required and taken in respect of the same during the year. The report shall also record the action taken by him, or on his advice, during the year, in regard to offensive trades, to factories and workshops, and to dairies. The report shall also contain tabular statements (on Forms to be supplied by us, or to the like effect) of the sickness and mortality within his District, classified according to diseases, ages, and localities:

Provided that, if the Medical Officer of Health shall resign or be removed before the Thirty-first day of December in any year, he shall thereupon make the like report for that part of the year during which he has held office.

(16.) He shall give immediate information to Us of any outbreak of dangerous epidemic disease within his District. He shall transmit to Us a copy of each annual report and of any special report made by him. On his advising the Sanitary Authority with a view to their requiring the closure of any school or schools, in pursuance of the Code of Regulations approved by the Education Department and for the time being in force, he shall forthwith report specially to Us the grounds of his advice.

(17.) At the same time that he gives information to Us of an outbreak of dangerous epidemic disease, or transmits to Us a copy of his annual report or of any special report, he shall give the like information or transmit a copy of such report to the London County Council.

(18.) In matters not specifically provided for in this Order, he shall observe and execute any instructions issued by Us, and the lawful orders and directions of the Sanitary Authority applicable to his office.

(19.) Whenever We shall make regulations for all or any of the purposes specified in Section 134 of the Public Health Act, 1875, as extended to London by Section 113 of the Public Health (London) Act, 1891, and shall declare the regulations so made to be in force within his District or any part thereof, he shall observe such regulations, so far as the same relate to or concern his office.

(7.)

MEMORANDUM as to ANNUAL REPORTS of MEDICAL OFFICERS OF HEALTH (PROVINCES).

Every medical officer of health, appointed under Order of the Local Government Board, is required to make an annual report with regard to each sanitary district, or division of a district, which is under his superintendence. This report is to be for the year ending the 31st of December, or, if the officer at that date has not been in office for a whole year, then for so much of the year as has elapsed since his appointment. The report is to made to the council by whom he is appointed, and the medical officer of health himself should send a copy of it to the Local Government Board and to the county council or county councils of the county or counties within which his district may be situated.* It should be made as soon as practicable after the expiration of the year to which it relates. The medical officer of health ought not, in general, to have any difficulty in doing this within a month or six weeks; but if from any special circumstances the report cannot be completed within six weeks, it should be understood that the delay must not be indefinite, and that the report should be in the hands of his council, and of the Board, within, at most, three months from the end of the year. The Board's copy of the report should be forwarded to them when the original is sent to the council,

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* Where the district for which a medical officer of health acted at the beginning of the year has, in consequence of any order made by a county council or joint committee under the Local Government Acts, 1888 and 1894, been placed under the jurisdiction of two or more councils, the medical officer of health should send to each council, either a report on the whole area for which he has acted during the previous year, or a report relating to so much of that area as on the 31st December of that year was under the jurisdiction of each council. If one report only be made, the medical officer of health should make such distinctions as will enable each council to ascertain the facts specially relating to its own district.

In cases where the local authority having jurisdiction over an area at the beginning of the year has ceased to exist, the medical officer of health should report thereon to the council or councils exercising authority over such area at the time that he makes his annual report.

except where the report is likely to be printed by order of the council. In such cases the Board need only be supplied with a printed copy. It is very desirable that the annual report should be printed, for the sake of facility of reference and in order that a supply of copies may be available for distribution among the town or district councillors and other persons interested.

Article 18 (Section 14) of the Board's Order of March, 1891, specifies the information to be contained in the annual report, and is annexed.

The report should be chiefly concerned with the conditions affecting health in the district and with the means for improving those conditions. It should contain an account, brought up to the end of the year under review, of the sanitary circumstances of the district, and of any improvement or deterioration which may have occurred during the year in these circumstances. Care should be be taken to report fully and explicitly on the influences affecting or threatening to affect injuriously the public health in the district, and on the action which has been taken, or which may still be needed, with a view to combat those influences. It is of especial importance that the medical officer of health should record what action has been taken to remedy unhealthy conditions which have been reported by him in previous annual reports, or in special reports presented during the year under review, and that attention should be called afresh, year by year, to such as remain unremedied.

As subjects concerning which the Board desire to obtain, through annual reports of the medical officer of health, not only definite general information, but record also of particular changes of condition that are occurring incidentally or by action of the local authority, the following deserve to be especially borne in mind:—

Physical features and general character of the district.

House accommodation, especially for the working class: its adequacy and fitness for habitation. Sufficiency of open space about houses and cleanliness of surroundings. Supervision over erection of new houses.

Sewerage and drainage: its sufficiency in all parts of the district. Condition of sewers and house drains. Method or methods of disposal of sewage. Localities where improvements are needed.

Excrement disposal: system in vogue; defects, if any.

Removal and disposal of house refuse—whether by public scavenger or occupiers: frequency and method.

Water supply of the district or its several parts: its source (from public service or otherwise), nature (river water, well water, upland water, &c.), sufficiency, wholesomeness, and freedom (by special treatment or otherwise) from risks of pollution.

Places over which the Council have supervision, *e.g.*, lodging houses, slaughterhouses, bakehouses, dairies, cowsheds and milkshops, factories and workshops, and offensive trades.

Nuisances: proceedings for their abatement—any remaining unabated.

Methods of dealing with infectious diseases: notification; isolation hospital accommodation and its sufficiency; disinfection.

With regard to such points it should be remembered that these reports are for the information of the Board and of the county council as well as of the council of the district, and that a statement of the local circumstances and history of local sanitary questions, which may seem superfluous for the latter, may often be needed by the former bodies.

The medical officer of health, in reporting his proceedings and advice, should put on record whether he has made systematic inspections of his district. By "systematic inspections" are meant inspections independent of such inquiries as the medical officer of health may have to make into particular outbreaks of disease, or into unwholesome conditions to which his attention has been specially called by complaints or otherwise, and such inspections will include the house-to-house inspections which may be necessary in particular localities.

In making systematic inspections, as in much of his other action, the medical officer of health will usually have required the assistance of the inspector of nuisances; and the medical officer should include in his report an account of the action which, at his instance, the inspector may have taken for the removal of nuisances injurious to health.

The report should deal with the extent, distribution, and causes of disease, especially of epidemic and notifiable diseases within the district, and should give an account of any noteworthy outbreaks of such diseases during the year under review, stating the result of his investigations into their origin and propagation, and the steps taken by him, or on his advice, with a view to check their spread.

The tabular statements of sickness and mortality in the district during the year, to be made on the forms supplied for the purpose, should be the subject of comment in the text of the report, in so far as deductions from them may assist the Board and the Councils concerned to an appreciation of the lines of action needful in the future.

It will be observed that the forms for record of statistical data supplied on the present occasion differ from those supplied in former years. Four tables have, at the suggestion of the Incorporated Society of Medical Officers of Health, been substituted for the Tables A and B previously in use. This has been done

with a view to facilitate record of a minimum amount of statistical information of the sort desired by the Board.

As regards these several tables a few observations appear to be needful :

In Table I should be stated for the whole district under the superintendence of a medical officer of health the number and rates of births, and of deaths under one year and at all ages, and the data on which the nett death-rate is based. Spaces are given for the insertion of the corresponding figures for the ten previous years for purposes of comparison, a comparison which will often yield points of interest. In most cases there should be no difficulty in obtaining the figures for former years from previous annual reports, but if owing to changes in the constitution of the district or for other reasons the figures cannot be ascertained for ten years, they should be given for as far back as they are available.

In Table II the births, and the deaths corrected by the exclusion of those of non-residents and the inclusion of those of residents dying elsewhere, are to be distributed among the localities to which they belong, space being given in this table also for the insertion of the corresponding figures in previous years. As regards the classification by localities, it is to be observed that the district under the superintendence of a medical officer of health may contain several parts evidently differing in their circumstances, or having very different rates of mortality, either from all causes, or from some particular disease or class of diseases. The observation of these differences can scarcely fail to lead to valuable information, especially when the returns for several years can be compared together, and it is in view of such differences that the tabular statements are required in Article 18 (Section 14) to be classified according to "*localities*," and that provision for such a classification is made in the forms supplied for returns of deaths. In the absence of any obvious differences of the above sort, it will still be desirable where the district is of any considerable size and has recognized sub-divisions to classify the deaths according to the part of the district in which they occur ; and for this purpose any areas of known population (such as wards, parishes or groups of parishes, or registration sub-districts) may be taken as representing "*localities*" for the purposes of the Order.

In small districts having no sub-divisions of known population Table II need not be filled up.

Table III provides for the number of notified cases of infectious disease during the year, classified according to ages of patients and localities, and also the number of cases removed to hospital from each locality. As regards the classification according to locality, the same considerations apply to the records of sickness as to those of deaths.

Table IV provides for the deaths during the year from various causes, classified according to ages and localities. In populous

districts a more extended table in a similar form containing a more complete classification of causes of death may with advantage be substituted for this form.

Great care should be taken to note carefully the headings and the footnotes before proceeding to fill the columns and the blank spaces in these tables.

What has been said above with regard to the information which an annual report should contain must be understood, not as suggesting that the report should be limited to these subjects, but as indicating the sort of information required by the Board's Order. Many medical officers of health will doubtless, with great advantage to the administration of their districts, furnish much more detailed information and statistics respecting particular questions to which they have been led by the circumstances of the foregoing year to devote attention, or in the investigation of which they may have arrived at definite conclusions. Any information of this kind will be appreciated by the Local Government Board.

W. H. POWER,
Medical Officer.

Local Government Board,
December, 1900.

EXTRACT FROM THE ORDER OF THE LOCAL GOVERNMENT BOARD.

23rd March, 1891.

Duties.

Art. 18. The following shall be the duties of the Medical Officer of Health in respect of the District for which he is appointed :—

(1.) He shall inform himself as far as practicable respecting all influences affecting or threatening to affect injuriously the public health within the District.

(2.) He shall inquire into and ascertain by such means as are at his disposal the causes, origin, and distribution of diseases within the District, and ascertain to what extent the same have depended on conditions capable of removal or mitigation.

(3.) He shall by inspection of the District, both systematically at certain periods, and at intervals as occasion may require, keep himself informed of the conditions injurious to health existing therein.

(4.) He shall be prepared to advise the Sanitary Authority on all matters affecting the health of the District, and on all sanitary points involved in the action of the Sanitary Authority; and in cases requiring it, he shall certify for the guidance of the Sanitary Authority or of the Justices, as to any matter in respect of which the Certificate of a Medical Officer of Health or a Medical Practitioner is required as the basis or in aid of sanitary action.

(5.) He shall advise the Sanitary Authority on any question relating to health involved in the framing and subsequent working of such byelaws and regulations as they may have power to make, and as to the adoption by the Sanitary Authority of the Infectious Diseases (Prevention) Act, 1890, or of any section or sections of such Act.

(6.) On receiving information of the outbreak of any contagious, infectious, or epidemic disease of a dangerous character within the District, he shall visit without delay the spot where the outbreak has occurred, and inquire into the causes and circumstances of such outbreak, and in case he is not satisfied that all due precautions are being taken, he shall advise the persons competent to act as to the measures which may appear to him to be required to prevent the extension of the disease, and take such measures for the prevention of disease as he is legally authorised to take under any Statute in force in the District, or by any Resolution of the Sanitary Authority.

(7.) Subject to the instructions of the Sanitary Authority he shall direct or superintend the work of the Inspector of Nuisances in the way and to the extent that the Sanitary Authority shall approve, and on receiving information from the Inspector of Nuisances that his intervention is required in consequence of the existence of any nuisance injurious to health, or of any overcrowding in a house, he shall, as early as practicable, take such steps as he is legally authorised to take under any Statute in force in the District, or by any Resolution of the Sanitary Authority, as the circumstances of the case may justify and require.

(8.) In any case in which it may appear to him to be necessary or advisable, or in which he shall be so directed by the Sanitary Authority, he shall himself inspect and examine any animal, carcase, meat, poultry, game, flesh, fish, fruit, vegetables, corn, bread, flour, or milk, and any other article to which the provisions of the Public Health Act, 1875, in this behalf shall apply, exposed for sale, or deposited for the purpose of sale or of preparation for sale, and intended for the food of man, which is deemed to be diseased, or unsound, or unwholesome, or unfit for the food of man; and if he finds that such animal or article is diseased or unsound, or unwholesome, or unfit for the food of man, he shall give such directions as may be necessary for causing the same to be dealt with by a Justice according to the provisions of the Statutes applicable to the case.

(9.) He shall perform all the duties imposed upon him by any byelaws and regulations of the Sanitary Authority, duly confirmed where confirmation is legally required, in respect of any matter affecting the public health, and touching which they are authorised to frame byelaws and regulations.

(10 He shall inquire into any offensive process of trade carried on within the District, and report on the appropriate means for the prevention of any nuisance or injury to health therefrom.

(11.) He shall attend at the office of the Sanitary Authority or at some other appointed place, at such stated times as they may direct.

(12.) He shall from time to time report in writing to the Sanitary Authority his proceedings, and the measures which may require to be adopted for the improvement or protection of the public health in the District. He shall in like manner report with respect to the sickness and mortality within the District, so far as he has been enabled to ascertain the same.

(13.) He shall keep a book or books, to be provided by the Sanitary Authority, in which he shall make an entry of his visits, and notes of his observations and instructions thereon, and also the date and nature of applications made to him, the date and result of the action taken thereon and of any action taken on previous reports; and shall produce such book or books, whenever required, to the Sanitary Authority.

(14.) He shall also make an annual report to the Sanitary Authority, up to the end of December in each year, comprising a summary of the action taken, or which he has advised the Sanitary Authority to take, during the year for preventing the spread of disease, and an account of the sanitary state of his District generally at the end of the year. The report shall also contain an account of the inquiries which he has made as to conditions injurious to health existing in the District, and of the proceedings in which he has taken part or advised under any Statute, so far as such proceedings relate to those conditions; and also an account of the supervision exercised by him, or on his advice, for sanitary purposes over places and houses that the Sanitary Authority have power to regulate, with the nature and results of any proceedings which may have been so required and taken in respect of the same during the year. The report shall also record the action taken by him, or on his advice, during the year in regard to offensive trades, to dairies, cow-sheds, and milk shops, and to factories and workshops. The report shall also contain tabular statements (on Forms to be supplied by Us, or to the like effect), of the sickness and mortality within the District, classified according to diseases, ages and localities:

Provided that, if the Medical Officer of Health shall cease to hold office, before the Thirty-first day of December in any year, he shall make the like report for so much of the year as shall have expired when he ceases to hold office.

(15.) He shall give immediate information to Us of any outbreak of dangerous epidemic disease within the District, and shall transmit to Us a copy of each annual report and of any special report. He shall make a special report to Us of the grounds of any advice which he may give to the Sanitary Authority with a view to their requiring the closure of any school or schools, in pursuance of the Code of Regulations approved by the Education Department, and for the time being in force.

(16.) At the same time that he gives information to Us of an outbreak of infectious disease or transmits to Us a copy of his annual report or of any special report, he shall give the like information or transmit a copy of such report to the County Council or County Councils of the County or Counties within which his District may be situated.

(17.) In matters not specifically provided for in this Order, he shall observe and execute any instructions issued by Us. and the lawful orders and directions of the Sanitary Authority applicable to his office.

(18.) Whenever We shall make regulations for all or any of the purposes specified in Section 134 of the Public Health Act, 1875, and shall declare the regulations so made to be in force within any area comprising the whole or any part of the District, he shall observe such regulations, so far as the same relate to or concern his office.

No. 17.

APP. A, No. 17.

Geological Considerations in relation to Public Health and Sanitary Administration; by Dr. Parsons.

REPORT on GEOLOGICAL CONSIDERATIONS in relation to PUBLIC HEALTH and SANITARY ADMINISTRATION; by Dr. PARSONS.

THE possession of accurate and sufficiently detailed information as to the nature of the subsoil and subjacent strata is of importance in a large number of cases in which there is question of danger to the public health, or in which sanitary works are proposed to be carried out. This is especially the case in relation to works of water supply from underground sources, whether the problem be that of providing a new supply, or the detection and prevention of danger of pollution of existing sources. Among the more material points in this connection may be mentioned the extent and position of the outcrop of permeable rock which forms the gathering ground; the degree of porosity of the rock as affecting the proportion of the rainfall absorbed and the thoroughness of the filtration which the water undergoes in passing through it; the level, quantity, and direction of flow of the underground water; the existence of fissures and channels which may facilitate the passage of the underground water, or of impermeable beds or faults which may limit its flow in particular directions; and the chemical composition of the strata as affecting the mineral ingredients of the water.

In investigating outbreaks of disease suspected to have been caused by polluted well water knowledge of such points concerning the water-bearing strata is often of essential importance.

Geological information has also a bearing upon other matters of sanitary administration. In the establishment of burial grounds and sewage irrigation works, the suitability of the soil and the possibility of pollution of underground water-sources have to be considered.

The nature of the subsoil, as affording stable dry and healthy sites for buildings, has to be taken into account, both in the erection of buildings of a public character and in framing bye-laws with respect to new buildings. The stability of buildings in particular situations may be endangered by the liability to land-slips, and, in the colliery districts, by subsidences, the result of undermining.

There is reason to suspect that the nature of the soil has influence upon the prevalence of particular diseases. It has long been known that phthisis is more prevalent, *cæteris paribus*, upon damp retentive soils than upon those of a drier nature, and observers have found reason to surmise that a relation exists between soil conditions and the endemic prevalence of certain other diseases, as typhoid fever, diarrhœa, and cancer.

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In studying these various questions, the published maps, &c., of the Geological Survey are of particular value. In relation to most of such questions the maps of the Drift Series, where published, are the most useful; but where deep wells or risks of undermining are concerned, the maps of the solid geology need to be consulted, and useful information is also sometimes to be obtained from the Horizontal Sections. The maps would, however, be more useful than they are but for the following circumstances:—*

1st.—The scale of one inch to a mile is, in many instances, too small to show the nature of the ground in the required detail, and it would be of advantage if maps were published on the 6-inch scale, not only of the mining districts but also of the populous regions in the neighbourhood of London and other large towns, if not indeed for the whole country.

2nd.—There are still many parts of the country for which the drift maps have not yet been published, even where drift is present in such abundance as to affect markedly the character of the surface.

3rd.—In the older maps the topographical details are often, through lapse of time, incomplete or incorrect. The strata, too, are sometimes not mapped in sufficient detail; beds of different lithological character not being distinguished. Thus, in the older maps, formations such as the coal measures and the millstone grit are denoted each by a single colour, although these formations are composed of alternations of beds of different lithological character —sandstones and shales—, and in relation to works of water supply and other sanitary matters the difference between sandstone and shale may be as important as if they were formations belonging to different geological epochs. These defects are mostly met with in the earlier maps, such as those of S.W. England, and more especially in South Wales, where, in the rapidly developing populous centres, the need for sanitary works is constantly arising, but where the maps of the old series are, for the reasons given, almost useless. A new survey of this region is now, I learn, in progress.

As showing how geological circumstances may be of importance, even in cases where they might appear at first sight to have little bearing, I may allude to a report on "Sewerage and Drainage Arrangements and the Pollution of Streams in certain Valleys in the Counties of Monmouth and Glamorgan," which was made by the late Mr. T. W. Thompson, Medical Inspector of the Local Government Board, and published in 1896. In this report it was found necessary to consider in some detail the geological structure of the region in question with reference to the probable life of the collieries in different places, and the consequent prospects of the maintenance of the existing populations at their present level, and of the springing up of populous centres in new regions.

* These defects are in course of being remedied as the Survey progresses.

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Upon the prospects of different localities in this respect the question of the sewerage arrangements appropriate to the needs of each locality largely depended. The question of possible fracture of sewers through subsidence of the ground, as the result of undermining, had also to be considered.

Where the published maps are not sufficient, or in cases in which more detailed information or explanation on geological points is needed, the Medical Department of the Local Government Board have often consulted, both by letter and by personal interview, the officers of the Geological Survey, and have received from them much courtesy and valuable advice and assistance. As illustrations of the value of the personal assistance of the Geological Survey to the work of the Local Government Board, I may mention the following instances :—

1. In 1869 the late Sir George Buchanan, then a Medical Inspector in the Medical Department of the Privy Council (afterwards transferred to the Local Government Board), was engaged on an inquiry into the distribution of phthisis as affected by dampness of soil. An enquiry made by him in the previous year into the results which had hitherto been gained in England by works designed to promote the public health, had shown that in certain towns where works of drainage had effected a drying of the subsoil, their execution had been followed by a marked diminution of the mortality from phthisis, while in other towns, where sewerage had not effected a drying of the subsoil, no such reduction of phthisis mortality had followed. It was then sought to verify the relation thus indicated between wetness of soil and prevalence of consumption by comparison of the rates of mortality from this disease in districts on retentive soils with those in districts on naturally dry soils. The general result of the enquiry, which was in full accordance with that of the previous one, was summed up by Dr. Buchanan in the words, "Wetness of soil is a cause of phthisis to the population living upon it." In his introductory remarks he says :—"The Geological Survey of England, advancing to completeness in its records of the great formations of the country, has hitherto mapped the minute surface geology only in the counties of Surrey, Kent, and Sussex. From the present point of view it is plain that surface peculiarities must be taken into account quite as much as the great divisions of the geologist—that brick-earth, drift gravel, river alluvium, and the like, have an importance in themselves apart from the character of the larger formations over which they lie. The three south-eastern counties, therefore, form the only area where the Survey yet affords materials for profitable detailed examination of soil as affecting the health of residents on it, and the present report will concern itself exclusively with them."

Among the materials for the report, Dr. Buchanan mentions the maps of the Geological Survey, with various unpublished sections and other documents placed at his disposal by the then Director-General (Sir R. Murchison), and minute information about the topography and geology of particular districts supplied by Mr. Whitaker and Mr. Topley, two of the geologists who had actually worked the three counties under examination.

These researches having shown that dampness of the soil was a cause of phthisis among people living thereon, attention was called to the importance of securing dryness of sites of houses. By the Public Health Act of 1875, local authorities were empowered to make byelaws with respect to foundations and walls of new buildings "for purposes of health," whereas previously they were empowered to make such byelaws only for the objects of securing stability and the prevention of fires. A model series of byelaws was framed by the Local Government Board and issued in 1877, and has since been widely adopted. Among the clauses are several with the aim of securing dryness of the habitation, as by requiring the provision of a layer of asphalte or concrete over the earth beneath the house, and of a damp-proof course in the walls; and, where necessary, the underdraining of damp sites and the levelling up of low lying ones.

To the attention paid in modern house building to secure dryness of foundations we may probably attribute a share, among other improvements in the housing and general well being of the people, in the remarkable decline which has taken place in recent years in the mortality from phthisis, to which attention is called by the Registrar-General in his annual report for 1897. This reduction, in the period 1891–97 as compared with 1861–70, amounted to 35 per cent. in males and 49 per cent. in females; and the circumstance that the reduction was greatest in the earlier stages of life in both sexes, and greater in women than in men, is consistent with the more healthful condition of dwelling-houses, in which women and children spend more time than men, having been one of the factors in bringing it about.

In the other examples which I shall quote, in which the personal assistance of officers of the Geological Survey was obtained, the geological data had a more local and immediate bearing.

2. In 1883 the Local Government Board had before them a proposal to supply the village of Holt, Norfolk, with water from a spring issuing from the foot of the hill on which the village stands. The situation of the spring did not suggest likelihood of contamination and the water was to outward appearance clear and good,

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but chemical analyses had thrown suspicion on its purity. Local opinion was in favour of its use, and it was stated that a deep boring into the chalk, made as an alternative source, had failed to yield a satisfactory supply. In reply to a request from the Board a report by Mr. H. B. Woodward was furnished, through the then Director of the Geological Survey. This report showed, first, that the position of the gathering ground from which the spring was fed was such that leakage from cesspools, &c., in Holt would reach the water on its way to the spring; and, second, that the borings into the chalk had not been carried deep enough to reach the water-bearing stratum.

3. In 1896 the Local Government Board received from the War Office a complaint of the unsatisfactory state of the drainage of Havant and Bedhampton, Hampshire, as endangering the purity of the Portsmouth water supply, which is obtained from springs in the Chalk at those places, and the Board were asked to investigate the matter. As geological considerations appeared to be largely involved, the Board suggested that the War Office should secure the co-operation in the inquiry of a member of the staff of the Geological Survey acquainted with the geology of the district, and Mr. Whitaker, F.R.S., then senior geologist, was accordingly associated with the Board's inspector, Dr. Theodore Thomson, in the inquiry. The report of Dr. Thomson, "On the Conditions, topographical, geological, and sanitary, of the Havant Districts (Rural and Urban) in their relations with the sources of the Borough of Portsmouth Company's Water Supply," was published in 1899, and contained, as an appendix, a memorandum by Mr. Whitaker on the geology of the neighbourhood of Havant in connection with the water supply of Portsmouth, illustrated by a geological map of the neighbourhood on the 6-inch scale and a section of the strata. In this memorandum Mr. Whitaker remarks that the geological lines which are of most importance in this connection, as shown on the new map (6-inch scale) differ a good deal from those on the old 1-inch map (sheet 11), which were drawn many years ago when drift was ignored, and when no evidence from borings existed. The old lines, indeed, he says, must be taken only as a sketch, and as one made at a time when the extension of beds hidden under drift was a matter of little interest.

4. In 1898 the Local Government Board had before them an application for sanction to a loan for water supply to the village of Maiden Newton, Dorsetshire. Evidence, however, was given at the local inquiry that the course of flow of the underground water was such that the springs from which the water was proposed to be obtained would be likely to be polluted by the drainage

of certain villages. Mr. Hawkins, of the Geological Survey, however, was able to advise the Board that the flow of underground water was in the contrary direction to what had been asserted, and that the springs were not likely to be polluted, and the objection therefore fell to the ground.

5. In January, 1900, the Local Government Board had occasion to consult the Geological Survey respecting the water supply and sewage disposal of a hospital which it was proposed to establish, with their sanction, at Defford, Worcestershire, and an inspection of the site was made by Mr. H. B. Woodward, of the Geological Survey, in company with one of the Board's medical inspectors. The proposed site of the hospital was on a limited patch of gravel overlying lias clay, and from Mr. Woodward's report it appeared that the supply of water which might be obtained from a well on the site might fail in exceptionally dry seasons; that pumping from a well at the hospital would diminish the amount of water obtainable from another well supplying people in the neighbourhood, and that the proposed well at the hospital would be liable to pollution both from the drainage of an existing farm-yard, and also from the disposal, by irrigation upon the site, of the sewage of the hospital itself.

6. The Local Government Board have recently had before them an application from the Coalville Urban District Council, Leicestershire, for a loan for works of sewage disposal. Objection was raised by the parishioners of a neighbouring village on the ground of danger of pollution of springs from which the water supply of the village is obtained. These springs are in a different valley to the proposed sewage farm, but it was feared that sewage might find its way into the springs through crevices in the carboniferous limestone upon which the intervening hill rests. A visit to the locality was made, at the Board's request, by Mr H. B. Woodward, of the Geological Survey, whose report indicated means by which any such risk might be avoided.

No. 18.

APP. A, No. 18.

Progress and Diffusion of Plague in 1900 by Dr. Bruce Low.

SUMMARY of the PROGRESS and DIFFUSION of PLAGUE in 1900; by Dr. BRUCE LOW.

In continuation of the summary contained in the Medical Officer's Annual Report for 1899, the following brief sketch of the distribution of plague over the world has been prepared. The detailed account to which reference was made in last year's summary, and which includes the incidence of plague, from the historical and geographical point of view, from 1898 to 1901, is being published in a separate volume, now nearly ready to be issued.

At the end of 1900 plague remained established in the four quarters of the globe. Many places now have a regular annual recrudescence of the malady, as for example India, Hong Kong, Formosa, Mauritius, Egypt, and Arabia.

From all accounts it would appear that plague is laying hold of the Western hemisphere. At Rio de Janeiro there has been a fresh recrudescence, and at San Francisco, though the number of reported cases has been comparatively small, the disease has continued to smoulder on for two years or more in the Chinese quarter. In South Africa, at the time of writing, plague bids fair to secure a firm foothold.

From a number of countries the information available as to plague is scanty. In countries like China the records of outbreaks are not collected, and in some Western countries the information, when collected, is kept secret and withheld from those in search of it. For this and other reasons the following summary cannot be regarded as complete.

INDIA.

Plague continued its ravages throughout a great part of India during 1900, the fifth year of its recent appearance in that country. The total number of recorded plague attacks during 1900 was 110,017, as compared with 176,155 in 1899; the certified plague deaths in 1900 numbered 92,106, as compared with 135,996 in 1899. This apparent diminution of the number of attacks and deaths gave rise to hopes that the plague epidemic in India was definitely on the wane; but unhappily these hopes have not been realised, for at the time of writing plague is continuing its ravages, and bids fair in 1901 to rival in amount the disastrous year of 1899, when plague was believed to have attained its maximum of virulence in India.

The appended table gives the distribution of plague throughout the various Provinces and States of India during 1900, and shows

that the Bombay Presidency continued to head the list of the Provinces most affected by the malady. Bengal unfortunately now bids fair to equal, if not to exceed, Bombay; for in 1899 the plague attacks in Bengal numbered only 3,657, and the deaths 3,250, whereas in 1900 the numbers had risen respectively to 40,294 and 38,412. Indeed, there were more deaths from plague in Bengal in 1900 than in the Bombay Presidency.

TABLE I.—Showing the Number of Plague Attacks and Deaths officially recorded in the various Provinces and States of India during 1900.

—	Population, 1891.	Recorded Plague Attacks.	Certified Plague Deaths.	Case Mortality. Percentage of Deaths to Attacks.
The Presidency of Bombay, including the City of Bombay	18,820,346	42,604	32,696	76·7
The Native States associated with the Bombay Presidency	9,324,241	6,527	5,093	78·0
The Presidency of Bengal, including Calcutta.	71,069,617	40,294	38,412	95·4
Presidency of Madras, including City of Madras.	35,641,828	915	685	74·8
North - West Provinces and Oudh.	46,905,085	156	122	78·2
Punjaub, including State of Patiala.	22,450,368	722	550	76·1
Central Provinces	9,531,560	655	607	92·6
Central India	10,318,812	1	—	—
Rajputana	12,220,343	19	14	73·6
Hyderabad State	11,537,040	1,112	938	84·3
Mysore State	4,843,523	17,008	12,987	76·3
Baluchistan	400,000	—	—	—
Lower Burma	4,510,697	4	2	—
Assam	5,021,084	—	—	—
Kashmir	2,543,952	—	—	—
		110,017	92,106	83·7

Up to the end of 1900 the total recorded plague attacks in India, since its appearance in 1896, had amounted to 514,447, and the certified plague deaths to 403,671.

PP. A, No. 18.

ogress and iffusion of ague in 1900; Dr. Bruce w.

The *City of Bombay*, where plague first manifested itself in India in 1896, continued to suffer in 1900, the recorded attacks numbering 17,915 and the certified deaths 13,247. The corresponding numbers in 1899 were 19,454 and 15,874. The distribution of the cases and deaths throughout the months of 1900 are shown in the table below :—

TABLE II.—Showing the incidence of Plague Attacks and Deaths Month by Month during 1900 in the City of Bombay.*

Plague.	1900.												Total during 1900.
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	
Attacks	2,732	3,142	3,635	3,007	1,774	563	443	353	574	598	543	551	17,915
Deaths	1,917	2,540	2,850	2,311	1,323	395	301	233	306	324	336	411	13,247

The *City of Calcutta* showed, during 1900, an increased incidence of plague, 8,822 cases and 8,278 deaths being recorded during the year, the corresponding numbers for 1899 having been 3,005 and 2,745.

The course of the 1900 plague outbreak in Calcutta is shown in the subjoined Table.

TABLE III.—Showing the incidence of Plague Attacks and Deaths Month by Month in the City of Calcutta during 1900.

Plague.	1900.												Total during 1900.
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	
Attacks	277	875	3,667	1,996	706	376	253	266	185	85	33	103	8,822
Deaths	263	799	3,326	1,935	684	366	248	261	184	85	32	95	8,278

Owing to the continued progress of plague in India, in spite of the comprehensive measures employed at great expense, and with production of grave friction among the native races of India, the Indian Government, in the Official Gazette of July 21st, 1900, published a resolution intimating that the elaborate precautions up to then in force were practically to be given up, in deference to the native prejudices and religious customs of India.

* This Table has been compiled from the weekly summaries telegraphed by the Viceroy to the India Office.

The departure of pilgrims for the Hedjaz of 1900-1901 was again forbidden on October 27th, 1900, for persons living in the Presidency of Bombay (with the exception of Sindh), the Presidency of Madras, the State of Mysore, Coorg, and the district of Jullundur in the Punjaub, and the Province of Bengal (with the exception of Chittagong). To other persons in India the only ports of departure for the Holy Pilgrimage were restricted to Karachi or Chittagong, and all such persons had to submit to a strict "observation" for some time before embarkation.

During the early part of 1901 plague showed no signs of diminution in India.

STRAITS SETTLEMENTS.

This colony, though in constant communication through shipping with infected ports, practically escaped from plague during 1900. Only two cases occurred in Penang in the month of October, the origin of the cases being unascertained. In December a single case occurred among a body of coolies landed at Singapore from the "Hong Wan," from Swatow and Amoy. Fortunately there was no extension of the infection at the time, though in the following month (January, 1901) another case, the first of a group which developed later, was recorded.

CHINA.

Plague, as is now well known, has been appearing in epidemic form in Southern China since 1894, and probably even before that date. The year 1900 gave no evidence of the subsidence of this epidemic manifestation of the disease in China. There was an outbreak of the malady in the spring of 1900 at Hoihow in the Island of Hainan, where in about six weeks no fewer than 2,000 persons are stated to have died of plague. Outbreaks occurred also at Macao, at Canton and its adjoining districts, at Swatow, Amoy and Foochow, as well as a number of other places.

At *Hong Kong* the disease re-appeared in January, 1900, becoming severely epidemic in May and June. The tabular statement below shows the progress of the 1900 plague outbreak in Hong Kong. But it is evident that many cases must have escaped observation since in several of the months the number of deaths was equal to the number of attacks, *i.e.*, only fatal cases came to light, non-fatal cases being successfully concealed, hence the apparent high case mortality rate of 94·7 per cent.

Plague.	1900.												Total in 1900.
	January.	February.	March	April.	May.	June.	July.	August.	September.	October.	November.	December.	
Reported attacks ..	5	9	6	80	278	387	198	86	19	13	3	3	1087
Certified deaths ..	5	8	6	69	256	358	204	85	19	13	3	3	1030

APP. A, No. 18.

Progress and Diffusion of Plague in 1900: by Dr. Bruce Low.

Since 1894 the reported plague cases in Hong Kong have amounted to 7,996 and the deaths to 7,302, a case mortality of 91·3 per cent.

The statistics of plague in other Chinese localities, as has been pointed out in previous reports, are extremely difficult to obtain, Chinese methods of reporting and registration being altogether untrustworthy.

JAPAN.

Plague appeared in the towns of Kobe and Osaka in 1899, and cases continued to be reported, though not in large numbers, in 1900. In Osaka from April to December some 116 cases and 99 deaths from plague were reported. In several other localities the malady also appeared, *e.g.*, at the seaport town of Yuasa. Japan being a country with considerable communication by means of shipping with other places, some of them known to be infected by plague, ran considerable danger of having the disease imported. Nagasaki and Yokohama dealt successfully with such instances of imported infection during 1900.

The Japanese authorities were conspicuous among the Eastern Nations for the successful way in which they carried out reasonable measures against plague, these measures being generally in conformity with modern European methods.

Formosa.—During October 1899 plague was becoming epidemic in Formosa, and from that date up to the middle of August 1900, 1,172 cases of plague were officially reported, of which 884 proved fatal. From August to December some 39 fresh cases occurred, the beginning of a fresh epidemic which raged in the early part of 1901.

The total plague attacks officially recorded in Formosa during 1900 amounted to 1,084, and the deaths to 807.

The Tainan district has been the chief sufferer from the repeated outbreaks of plague in Formosa. The total cases in the Tainan district in 1900 numbered 533 and the deaths 357, as compared with 2,241 attacks and 1708 deaths in 1899.

THE PHILIPPINES.

In the early part of 1900 plague was reported to have broken out at Manila, the first cases having been recognised during the latter part of December 1899. The official records give the number of cases of plague in Manila during the year as 271, and of these, 199 or 73·4 per cent., proved fatal. It is however generally admitted that these figures fall far short of the actual numbers, many plague cases in the earlier months of 1900 having been certified as Beri-Beri, and under other headings.

From Manila the infection was carried to Cavite, Malabon, and San Pedro Macote. A group of cases also occurred in Cebu, another island in the Philippine group.

NEW CALEDONIA.

In December, 1899, plague was admitted to have broken out at Numea, and cases continued to occur up to the end of April 1900. An official report on the outbreak, by Dr. Primet, states that 124 cases and 80 deaths were certified from plague, viz. :—

District.	Cases.	Deaths.
Numea	97	64
La Foa	1	1
Neponi	14	8
Thio	5	3
Ile Nou	7	4
Total	124	80

Dr. Primet expresses the opinion that the infection was "probably imported from Sydney by means of jute bags from India transhipped at Sydney without disinfection." On the other hand Sydney is believed to have received its infection from Numea which was the first of the two to suffer. Rats were recognised to be suffering from fatal illness at Numea, Thio, and Neponi before the disease attacked human beings.

In framing measures to prevent the spread of plague, the Authorities of New Caledonia prohibited the importation, among other things, of jute bags, rice, maize, copra, a prohibition hardly consistent with the spirit or the letter of the Venice International Convention of 1897.

AUSTRALIA.

New South Wales.

As was mentioned in last report plague became epidemic in *Sydney* during 1900, the first case being reported on January 24th, and the last on August 11th. The total certified cases numbered 303, and the deaths 103, a case mortality of about 34 per cent. The height of the epidemic was reached about the beginning of May.

It is regarded as probable that the infection reached Sydney from New Caledonia, cases of plague having occurred there during December, if not earlier. The island of New Caledonia is only three and a half days by steamer from Sydney. It is believed that the infection came by means of rats, since a fatal epidemic raged among rats on the Sydney wharves before the disease attacked human beings. The first cases of plague among the population were confined to those persons who lived or worked on or near the wharves.

QUEENSLAND.

During April, 1900, the existence of plague among rats in the wharves at *Brisbane* was discovered, and in the following month human beings began to suffer from the disease. There was no great outbreak, but a succession of scattered cases continued to occur from May to December. The number of cases officially recognised was only 56, of which 24 were fatal. It is not known how the infection was carried to Brisbane, but the fact that rats were first attacked has suggested that possibly infected rats from Sydney had carried plague on shipboard to Brisbane.

Rockhampton, the second largest town in Queensland, situated about 420 miles north-west of Brisbane, was also invaded by plague during 1900. In May the first case was reported, and the last in September. Altogether 36 attacks, 21 fatal, came under observation during the year.

In *Townsville*, a port in North Queensland, about 370 miles north of Brisbane and 450 from Rockhampton, plague appeared in April, 1900. Scattered cases continued to be reported up to September; but there was no epidemic, only 37 cases, 9 of them fatal, being officially recognised.

Cairns lies 200 miles north of Townsville. Plague was reported at this place in May, 1900. Official reports mention only five cases and two deaths up to the end of July.

Single plague cases were also reported at *Ipswich*, near Brisbane, and at *Chambers Towers*, which is a mining centre in the Davenport district of Queensland.

Altogether, during 1900, there were certified officially in Queensland 139 plague cases, 57 of which proved fatal, a case mortality of 41 per cent.

WESTERN AUSTRALIA.

In April, 1900, a single plague case occurred at *Freemantle*, and in May the infection was stated to have reached *Perth*. In May also a single case was reported from *Coolgardie*. There was no epidemic, however; the cases probably were the result of imported infection. No epidemic among rats was noticed at any of these places.

SOUTH AUSTRALIA.

In January, 1900, a case of plague was recognised at *Adelaide* in a runaway sailor, who had deserted six weeks before from a German ship. His illness began at *Gawler*, a small town some miles north of Adelaide; a second case also occurred in the same place. But some doubt was expressed at the time regarding the correctness of the diagnosis. During March, however, several suspected cases came under observation in Adelaide, 5 of them proving fatal. Scattered cases continued to come under observation up to August. In all 13 cases and eight deaths were reported during 1900.

VICTORIA.

An epidemic of plague among rats was discovered in the wharves at *Melbourne* in April, 1900, and two cases in the human subject occurred at the end of the same month. Early in May a case was found at *Collingwood*, a suburb of Melbourne, and about a fortnight later a group of four cases in one family at *Kensington*, another Melbourne suburb. At the seaport town of *Geelong*, 45 miles from Melbourne, a fatal case was also reported about this time, and during the same month (May) a suspicious case occurred on board H.M.S. *Cerberus* while off Melbourne Port. Fortunately, notwithstanding these various foci of infection, there was no epidemic.

NEW ZEALAND.

As was mentioned in the last report, the rats on the wharves at *Auckland* were found to be infected with plague in April, 1900. A single case in the human subject occurred during the same month, attributed to the bite of an infected rat. Here, again, no extension of the infection took place, notwithstanding the presence of rat infection in the port.

THE SANDWICH ISLANDS.

Plague appeared in these islands in the middle of 1899, and continued to manifest itself during the first three months of 1900. The disease was brought to Honolulu by a Japanese-American vessel from Hong Kong in June, 1899; indeed there is a probability that plague infection had occurred on several vessels which arrived at Honolulu during the summer of 1899. "Pneumonia," with a high rate of mortality, is stated to have prevailed in Honolulu during December, 1899; the total deaths from all causes were in that month more than double the average number for the same period in previous years. These facts lead to the inference that fatal plague had been occurring before the disease was recognised.

The last reported plague case was certified on March 31st, 1900, and on April 30th Honolulu was declared free from the disease. No definite figures have been obtained showing the precise number of plague attacks and deaths which occurred in Honolulu during 1900.

The infection was carried to two other islands in the group, viz., Maui and Hawaii.

With the exception of a suspected plague case on board a steamer, which arrived at Honolulu from Kobe in August, no further cases were reported during 1900.

NORTH AMERICA.

CALIFORNIA.

During March, 1900, plague was recognised by the Health Authorities of *San Francisco* to have occurred among the Chinese population of the city. Up to the end of the year

22 cases—all fatal—had come under observation. Since all of the attacks occurred in the Chinese quarter many of the leading residents in San Francisco refused to admit that plague existed in the city, notwithstanding that 10 of the earlier cases had been verified by post-mortem and by bacteriological examinations. The 22 cases reported do not, admittedly, comprise the whole of the plague cases which occurred in San Francisco during 1900. The Chinese population used every means in their power to conceal patients and to mislead the health officials in their investigations. Further cases continued to occur in the early part of 1901, a proof that the malady still smouldered in the city.

It is believed that the plague infection was brought to San Francisco by Chinese emigrants who travelled from Southern China to California *viâ* Japan and Honolulu, in all of which places plague was, or had been, prevalent before the malady broke out at San Francisco.

Mention was made in the last report of a group of cases landed by a Japanese steamer at *Port Townsend* in January, 1900, and which were at first regarded as cases of *beri-beri*. Fortunately there were no other cases of plague-like illness reported at Port Townsend during the rest of 1900.

BRITISH HONDURAS.

During March, 1900, the Colonial Surgeon at Belize was notified of the occurrence of an illness, attended with glandular swellings, at two localities within the colony. A medical investigation showed that during February and March, in a small fishing settlement with a population of 60 persons, some 13 cases of the malady had occurred. The symptoms were chiefly fever with tenderness and swelling of the glands in the neck, the groin, or armpit. The report viewed the cases as gravely suspicious of plague, and it was regarded as possible that the infection might have been brought by ships arriving at Belize in ballast from Rio de Janeiro, where at the time plague existed. In the summer months of 1900 there was a prevalence of illness in Belize marked by painful glandular swellings, lasting, however, only a few days. The ailment was regarded by some as "pestis minor." Up to the time of writing there had been no further developments of plague-like disease in the colony.

SOUTH AMERICA.

Paraguay.

Plague was epidemic in *Asonçion* during the autumn of 1899, and continued to show itself up to March, 1900. In July following, the disease after seeming disappearance, again broke out, but seemingly in a milder form. Opinions locally were divided as to whether the reappearance of plague at Asonçion was due to a reimportation of infection by grain ships from Argentina, or was a recrudescence of the infection already existing in the city. The records of cases have not been made public, and it is therefore

difficult to arrive at the number of attacks and deaths from plague which occurred in Asonçion during 1900. One authority, however, states that from April to December 127 cases, 56 of them fatal, occurred in the city.

It is believed that the infection of plague was brought by infected rats on board a steamer to Asonçion in April, 1899. This vessel was a regular trader to the port, and had transhipped a cargo of rice in bags at Montevideo from a sailing vessel which had loaded the rice at Rotterdam. These bags of rice had come to Rotterdam from India on another steamer. It is stated also that illness in rats and among the crew had occurred on board the sailing vessel on its voyage to Montevideo, and on board the steamer on its passage up the River Plate to Asonçion.

Towards the end of October it was reported that a number of suspicious cases resembling plague had occurred at *Villa Concepcion*, a town situated on the Paraguay River, about 150 miles due north of Asonçion. A medical investigator was sent by the Government to make inquiries, with the result, it is said, that the diagnosis of plague was not definitely verified.

The Argentine Republic.

Rosario di Santa Fè.—In January, 1900, bubonic plague was officially declared to be present in Rosario, but rumours had been rife that the disease had gained a footing in that port some months earlier. There are grounds for believing that plague was recognised in Rosario three months at least before it was officially reported. The cases generally had been of a mild type, and consequently concealment was not difficult. For this reason apparently no reliable statistics have been made public regarding the actual number of plague cases and deaths which occurred in Rosario during 1900. The first recognised cases occurred at a mill among persons who were employed in unloading maize from a ship for conveyance to the mill. Rats were known to have been dying about the wharves in large numbers previous to the appearance of plague among these men.

It is estimated that altogether about 200 persons were attacked by plague during 1900, and that about 100 of them succumbed to the disease.

It is not definitely known how Rosario became infected. Some believe the infection was brought from Asonçion; some, on the other hand, think the disease was brought by rats on ships from some infected port in the East. Rosario is a great shipping port for grain, and ships from all quarters come there for grain cargo.

Buenos Ayres.—About the same time that Rosario was declared infected, rumours were afloat that Buenos Ayres had also been invaded by plague. The number of recognised attacks was comparatively small, for up to the end of May only 120 attacks had been recorded. The type of the disease is said to have been distinctly mild. On June 5th, 1900, the Government declared Buenos Ayres free from plague. It is not yet definitely known

how Buenos Ayres became infected. But information on plague matters is not easily obtained from the officers of the Argentine Government.

San Nicholas is a town situated on the Parana River. During December, 1900, a number of cases of illness suspiciously like plague occurred among the workmen on the wharves, and about the same time dead rats were found in the warehouses where the labourers worked. Of 18 cases reported at the time, eight died. Later reports state that cases occurred in January and February, 1901, but definite numbers are not given.

Tucuman, a town situated to the north-west of the Argentine Republic, became infected by plague in December, 1900, 10 cases developing in a week and four of them speedily proving fatal. It is believed that a number of cases were concealed; no official report on the outbreak has been made public. It is believed that the infection was introduced by some Brazilian workmen.

In the early weeks of 1901 suspected plague was reported to have occurred in several other towns in Argentina.

BRAZIL.

Santos.—On October 18th, 1899, the Government of the State of Sao Paulo declared the city and port of Santos to be infected by plague. But it was known that in the preceding July cases of a kind suspiciously resembling plague had been appearing. Cases continued to occur during the early months of 1900, but as the epidemic was of a mild type little alarm was created. As elsewhere in South America there is an absence of definite information from Santos as to the actual amount of plague which occurred in the city and port during 1900.

It was at first believed that the infection had been imported from Portugal, but this is now denied. A remarkable mortality among rats was observed in July, 1899, and again in the following September, and it is assumed that the infection was ship-borne, and attacked the rats first.

The infection of plague was carried from Santos by vessels to several other foreign ports, and by land to Sao Paulo, a city some 50 miles distant. Here the disease appeared in November, 1899, till February, 1900. No statistics of the outbreak have been published.

Rio de Janeiro.—In January, 1900, plague was first recognised in this city as having attacked two children. About the same time rats were dying in large numbers in the quarter which furnished the two cases. No further cases were recognised till April, when a family, recently arrived from Oporto, were attacked. From this time the disease developed epidemic proportions, and continued to prevail to the end of the year and in the early months of 1901. The subjoined tabular statement shows the progress of the

epidemic so far, at least, as reported cases go. There were, it is asserted, other cases which were purposely concealed or which were classed under other headings.

—	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total reported cases in 1900.
Plague attacks.. ..	2	—	—	7	61	154	142	92	31	33	36	24	587

Of these 587 cases 301 proved fatal. A case mortality of 51·2 per cent.

It is not known definitely how plague reached Rio de Janeiro. The disease at the time existed in other South American ports, and might very well have been carried from one to the other. Plague infection also existed in Portugal in the autumn months of 1899, and owing to the communications between these places by ships, the disease might have been imported in that way.

Petropolis.—In the autumn months of 1900 plague was carried from Rio de Janeiro to Petropolis, which is about three hours railway journey to the north-east of Rio de Janeiro. It was officially admitted that six cases (three fatal) occurred in this town in October and November, 1900.

Nictheroy was also infected from Rio de Janeiro. Altogether seven cases (six fatal) occurred in the place during December, 1900. From Nictheroy the plague infection was carried to the neighbouring town of *S. Goncalo.*

Ceara, in the north of Brazil, came under suspicion of being infected by plague in the autumn of 1900. Although a number of suspicious cases occurred having resemblance to plague, yet an expert, who was sent from Para by the Brazilian Government to investigate the outbreak, was unable to definitely confirm the diagnosis of plague.

Illness of a suspicious kind also occurred during the latter part of 1900 in various other parts of Brazil.

EUROPE.

ENGLAND AND WALES.

During 1900, no fewer than 23 ships were reported to have arrived in ports of England and Wales, each with one or more suspected plague cases on board at the time of arrival. But strict bacteriological investigation failed to support diagnosis of plague except in four instances, (*see* "ship-borne plague and suspected plague in English ports during 1900," page 285). In each of these instances the usual measures were employed to prevent the spread of the disease, and with complete success.

Throughout the year, the medical profession of England and Wales kept a sharp look out for cases that might prove to be plague. In nine instances was suspected plague notified to the Board, and a specimen of material from the patient forwarded for examination by the official bacteriologist. But in no instance was the suspicion of plague bacteriologically confirmed.

SCOTLAND.

Glasgow.—In August, 1900, a number of cases of suspicious illness came under the notice of the health officials of the City of Glasgow, and investigation by modern bacterioscopic methods ultimately confirmed the diagnosis of bubonic plague. The spread of the plague appeared largely to be associated in the first instance with attendance at one or another of two wakes, held over the bodies of persons who had died of anomalous illness. Altogether there were recognised 36 cases of plague in Glasgow from the beginning of August to the end of September, 1900. Of these 16 proved fatal, a case mortality of 44·4 per cent.

It is not known definitely how the plague infection was introduced into the city, but it is surmised that the disease was brought to Glasgow by some Asiatic seaman arriving from an infected port, suffering from a mild or unrecognised attack which had received no medical attention.

Though rats were not scarce in the infected area, none of these animals were found affected by the disease, notwithstanding careful and continued examination of many rats secured in the locality for the purpose.

It speaks well for the health administration of so large a city as Glasgow, that, though plague had, unrecognized, gained a footing among what may be regarded as a susceptible population, the vigorous measures carried out by the Corporation's staff, limited the disease to a comparatively small number of cases.*

PORTUGAL.

Plague was epidemic in *Oporto* during 1899, and cases were reported up to February, 1900, when the city was declared free from infection. In June, 1900, a single case of plague was reported, but no official report regarding the origin of the case has been made public. It is, however, generally believed that this case was not a solitary one, and that it was in all probability one of a series of mild or unrecognised cases. But the health authorities of Oporto, since the plague outbreak of 1899, have afforded little information to outsiders on the subject. That the disease has not become extinct at Oporto is proved by the fact that a further group of cases occurred during the summer of 1901.

* For nine months Glasgow remained apparently free from plague, but in August and September, 1901, a few cases were reported, and this time rats were recognised as suffering from the disease.

SPAIN.

In February, 1900, a case with symptoms resembling plague was reported at *Tuy*, on the Spanish-Portugese frontier. The person attacked had recently arrived from Brazil, and this added to the suspicion. Apparently no bacteriological test was applied, and no definite official pronouncement regarding the case was made public. In April, 1900, the s.s. *Montevideo* arrived at Barcelona from Manila with two suspected plague cases on board, both of them discharged Spanish soldiers returning home. There had been three deaths during the voyage, but from what cause has not been stated. The ship's surgeon did not regard the two cases in question as plague, but nevertheless the Barcelona authorities sent the ship and its 300 passengers to undergo 10 days detention at Port Mahon. No other suspicious cases followed.

GERMANY.

Hamburg.—The s.s. *Rosario* arrived at Hamburg from the River Plate on July 30th, 1900, when the steward was found to be suffering from illness afterwards found to be plague, and of which he died on August 10th. No other cases followed. The vessel had called at Cardiff on the voyage from South America to Hamburg, and it was thought possible by the German authorities that the steward had been infected there. But strict investigation at Cardiff failed to find any trace of plague, or suspected plague cases, or infected ships, in that port.

Bremen.—The s.s. *Marienburg* arrived at Bremen on October 27th, 1900, from Buenos Ayres, having touched at Hamburg to unload part of its cargo before proceeding to Bremen. The crew were paid off on arrival at Bremen, and on October 30th one of them was found to be suffering from illness of which he died on November 5th. The cause of death was proved to be plague. Dead rats had been found on board the ship during the voyage.

FRANCE.

Marseilles.—On the arrival of the s.s. *Niger* from Constantinople and Levantine ports at Marseilles, on August 26th, 1900, it was found that two cases of plague had recently occurred on board the ship, which had left behind at Clazomene, the Turkish quarantine station, other two plague cases. These two antecedent cases had been discovered on the vessel at Constantinople on August 22nd. After arrival at Marseilles the vessel was sent to the Frioul sanitary station and landed there the two plague cases, one being the ship's surgeon. While undergoing detention two fresh cases developed, on August 30th and 31st respectively; and yet two more occurred within the next few days, both of the latter being medical men who had been sent from Marseilles to attend the plague cases landed at Frioul from the *Niger*, and who it was reported had been previously injected with Yersin's anti-plague serum. Thus, between August 25th and September 5th, six plague cases occurred in connection with the *Niger* (in addition to the two cases detected at Constantinople). Of the six cases at Frioul only one proved fatal.

RUSSIA.

In November and December, 1900, an outbreak of plague occurred in the village of *Vladimirovka*, in the Province of Astrachan. The malady was at first mistaken for typhus fever, but was proved, by a Government expert despatched to the place, to be true plague. In the village 25 cases and 16 deaths were recorded up to the end of December. About the same time another outbreak of plague was reported in three Kirghiz encampments near the village of Tolovka, in the Province of Samara, 61 cases and 41 deaths being recorded.

In the *Caucasus*, at the village of Tchiatoury, an outbreak of "infectious pneumonia" came under notice in May, 1900. The Russian Government's expert despatched to the scene of the epidemic was not able to confirm the diagnosis of plague, but the circumstances of the outbreak excited considerable suspicion.

TURKEY.

Constantinople.—In August, 1900, a case of plague was discovered in a passenger on the arrival of the s.s. *Niger* at Constantinople from Alexandretta and other Levantine ports. A second case developed at the same time in the person of one of the stewards of the vessel. Both patients were sent to the quarantine station at Clazomène. Though the *Niger* was "disinfected" before sailing for Marseilles six other cases of plague developed subsequently in connexion with her. The ship is stated to have been infested with rats, among which a considerable mortality had been observed during the two previous voyages. No further cases were reported from Constantinople during 1900.

Smyrna.—In May, 1900, a group of four cases of plague came under observation in Smyrna, and in June and July 18 fresh cases were reported: a total of 22 attacks of which nine proved fatal. The first persons attacked were Jews, and all of the 22 with a single exception were males. It was believed that a number of other mild cases escaped notice. Opinions were divided as to the origin of this outbreak; some believed that the infection was brought from the Hedjaz by pilgrims who had sold infected clothing to Jewish dealers, others held that the infection was imported by means of fruit from Alexandria.

Trebizonde.—At the beginning of June, 1900, plague was reported to have appeared at Trebizonde. It was believed the infection had been brought by a pilgrim from the Hedjaz.

Beyrout.—In July, 1900, four cases of plague were reported at Beyrout; 3 of the persons attacked worked in the same sweetmeat factory, the fourth patient being a relation of the others. Investigations showed that similar illness had attacked another worker in the same establishment about six weeks previously. The theory held locally as to the origin of these cases was that infection had been brought from India or Egypt by means of grain-bags. But this explanation, though accepted in Turkish circles, is not supported by any trustworthy evidence.

Egypt.

Alexandria.—Plague was epidemic in *Alexandria* during 1899, but only 93 cases were recorded. Early in 1900, a fresh outbreak occurred but on a scale even smaller than that of 1899, for only 35 cases, 20 of them fatal, came under observation during the year. At the time of the second plague outbreak in Alexandria, a considerable mortality among rats was observed. A third outbreak developed in 1901.

Port Said was declared infected by plague in May, 1900, but previous to this there had been a prevalence of illness, dating from March, variously described as "Influenza with glandular swellings" "Infectious" or "Cerebral" Influenza, "Influenza with phlegmons" &c. Eighty nine plague cases were reported between May and July, and 35 proved fatal. The diagnosis in all the earlier May cases, was bacteriologically confirmed. A further outbreak occurred in 1901.

Suakim.—During May, 1900, three cases of plague were reported, two proving fatal, at Suakim. Rats were observed to be dying in some numbers at the time these men were attacked. Fortunately there was no further spread of the infection from these cases.

Arabia.

Djeddah.—Plague appeared in Djeddah in 1899, prevailing from February to June. During 1900 the disease was again reported, 81 deaths being officially notified between April and July. The health authorities, after inquiry, expressed the opinion that in 1900 plague was re-imported by the clandestine landing of persons on the coast from infected places.

Yambo.—This port suffered in 1900, from March to June, from plague, 67 fatal cases being reported. It is stated that the first recognised case had been landed surreptitiously in a sambouk from Upper Egypt.

Assyr.—Plague is believed to be endemic in Assyr, and an annual outbreak of the disease has been observed for a succession of years. The Russian Imperial Plague Commission declared Assyr infected by plague in January, 1900. Later reports state that the disease had been occurring in a number of villages from January to April. In one village of 83 inhabitants some 46 plague cases with 21 deaths were recorded.

Aden.—In February, 1900, plague appeared at Aden and was epidemic there up to June. Altogether 708 cases with 576 deaths came under notice. The course of the epidemic may be followed in the subjoined table, which gives the cases and deaths reported from February to June:—

—	1900.												Total in 1900.
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	
Plague attacks ..	—	20	127	406	137	18	—	—	—	—	—	—	708
Plague deaths ..	—	10	100	330	122	14	—	—	—	—	—	—	576

The general assumption in Aden was that the infection had been brought from India on board grain ships by rats.

Muscat.—In January, 1900, plague was reported to have broken out in Muscat, and it continued to be epidemic there during February and March.

Bassorah.—A single plague case occurred in January, 1900, on board an English steamer from Bombay during the voyage to Bassorah; but the patient was convalescent on arrival. The ship was detained 15 days in quarantine. No further cases occurred at that time.

PERSIA.

In March, 1900, plague was reported to have broken out at Jivanro, in Persian Kurdistan, not far from the Turco-Persian frontier. Several villages were affected. Up to April, 1900, 142 plague deaths had been recorded in the locality.

In April it was reported from Teheran that plague had invaded Kermenshah, a probable extension of the Jivanro epidemic. During May, 1900, plague appeared on the island of Kischim, in the Persian Gulf, 18 cases being observed, with 11 deaths, during the first three weeks of May.

AFRICA.

BRITISH SOMALILAND.

In April, 1900, when plague was epidemic at Aden, the disease was carried across to British Somaliland on the opposite African shore by refugees fleeing from the pestilence. Among these panic-stricken refugees two fatal plague cases were observed in persons from Aden detained at the sanitary station at *Berbera.* Fortunately, no extension of the malady followed.

ZANZIBAR.

During 1900 there occurred about 12 cases as to which suspicion of plague arose. Bacteriological investigation did not confirm the diagnosis of plague in any of them.

UGANDA.

In 1900 a few plague cases came under observation in Southern Budda and Koki. But there was no recognised epidemic.

MADAGASCAR.

There had been outbreaks of plague in Madagascar in 1898 and in 1899. In October, 1900, the malady reappeared at Tamatave; but only a few cases were officially recorded, some 13 in all, 8 of them fatal.

RÉUNION.

During 1899, plague had appeared in the island of Réunion. At the beginning of January, 1900, a few cases were reported, the last of the outbreak which had begun in April, 1899. From the end of January till the end of August, 1900, no further cases came under notice. But in September a few fresh cases, bacteriologically proved to be true plague, occurred. Another group of cases was observed in December, and cases, though not in large numbers, continued to be notified up to the end of February, 1901.

MAURITIUS.

Plague was epidemic in Mauritius during 1899, and at the beginning of 1900 the outbreak had not subsided; cases continued to be reported during the first three months of the year. In July, after a practical cessation of the epidemic for about three months, a fresh outburst began to develop, and continued to manifest itself to the end of 1900, extending into the early months of 1901. The following table shows the distribution of plague attacks and deaths in Mauritius during 1900, the total number of cases recorded being 796, with 574 deaths :—

Plague.	1900.												Total in 1900.
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	
Attacks	48	25	28	6	2	2	15	26	61	194	208	181	796
Deaths	35	22	19	3	2	1	14	17	44	128	163	126	574

NATAL.

A single plague case imported from Mauritius occurred in Durban in May, 1900, but no extension of the infection followed.

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Progress and Diffusion of Plague in 1900; by Dr. Bruce Low.

KAFFRARIA.

During November, 1900, a malady suspected to be plague broke out among the native population at *Izeli*, eight miles from King William's Town. Thirteen persons were attacked and five succumbed to the disease. Bacterioscopic examination confirmed the diagnosis of plague. Another outbreak of the same kind was discovered in another native location in the same neighbourhood shortly afterwards.

CAPE TOWN.

As was mentioned in my report for 1899, plague was brought to Cape Town from Rosario by a freight ship, on board which altogether five cases occurred. There was no recognised case of plague in the Cape Peninsula during 1900. Early, however, in 1901 an outbreak of plague commenced, investigation of which revealed the fact that there had been an epidemic among rats in the docks as far back as August, 1900; and further there appeared ground for belief that plague cases among native labourers at the docks began to occur not long after disease had effected the rats. Particular cases which occurred in November; are now, in the light of further information, regarded as instances of true plague, not recognised at the time. Plague became epidemic in Cape Town in the early months of 1901.

SENEGAL.

Statements made in the public press during July, 1900, from special correspondents in West Africa, led to the inference that there had been an outbreak of plague in Senegal, deaths having been reported from this cause at Dakar and Sorée. A suspected plague death is stated to have occurred not long after this on board a French steamer on its voyage from Dakar to Pauillac. There is no information to show how plague reached Senegal, but as the disease was epidemic in the French Ivory Coast during 1899, it is probable it was imported from the one French Colony to the other.

No. 19.

MEMORANDUM on PLAGUE and SUSPECTED PLAGUE in ENGLAND and WALES during 1900, and on certain PRECAUTIONARY MEASURES employed to prevent the IMPORTATION and SPREAD of the DISEASE; by DR. BRUCE LOW.

APP. A, No. 19.

Plague and suspected plague in England and Wales in 1900; by Dr. Bruce Low.

(a) *Inland Cases reported as Suspected Plague, but which on investigation were found not to be of the nature of Plague.*

During 1900 nine instances came under the notice of the Medical Department in regard of which, from the clinical characters of the illness, suspicion of plague had arisen. But in each instance a diagnosis of plague was distinctly negatived by careful investigation and by the application of bacterioscopic tests. All of these nine instances were reported during the last four months of the year. The following is a brief summary of the facts :—

(1) *Buckinghamshire.*—The first suspected plague case reported was from an urban district in Buckinghamshire during September. The patient, who had gone to stay with friends, usually resided in London in the Knightsbridge district, and worked at Long Acre as a carriage painter. When first medically examined he was found to have a glandular swelling in each groin, with a slight amount of feverishness. There was no evidence of venereal disease. Material from the swollen glands was examined by the Board's bacteriological expert, who pronounced the results to be wholly negative as regards plague.

(2) *North Shields.*—A man was admitted on September 21st to the Tynemouth infirmary suffering from a tumour in the right illiac fossa and enlargement of glands in various regions. He had fever, with prostration and emaciation. Material taken from one of the enlarged glands was sent for examination to Dr. Klein, and also to Dr. Murray, of Newcastle-on-Tyne. Both of these experts reported the results to be negative *quâ* plague,

(3) *London.*—During October a case of suspicious illness occurred in the Limehouse district, East London; but bacterioscopic investigation forbade the opinion that the illness could be regarded as plague.

(4) *London.*—During October, in another London district (Clerkenwell), a similar case was also reported; and,

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Plague and suspected plague in England and Wales in 1900; by Dr. Bruce Low.

as before, the bacteriological evidence by the Board's expert was negative as to plague.

(5) *London.*—In the same month yet another suspicious case came under observation at Paddington, which was visited by Dr. Cantlie, a plague expert employed for the purpose by the London County Council. Dr. Cantlie pronounced the patient to be suffering not from plague, but from another disease.

(6) *West Ham.*—At the end of October, at Canning Town, in the Borough of West Ham, a case of suspected plague was notified to the Medical Officer of Health. Material taken from the patient was forwarded to Dr. Klein for examination, and he reported the result to be negative as to plague.

(7) *Bootle.*—During November a dock labourer was admitted from a common lodging house, in the town of Bootle, to the Borough Hospital, suffering from glandular swellings in the groin, armpit, and neck. He died a month later with acute symptoms. A post-mortem examination was made by Dr. Balfour Stewart, of Liverpool, who also conducted a bacteriological investigation with material taken from the case. Portions of the same material were sent to Dr. Klein, the Board's bacteriologist. The facts reported by these experts showed that the man had not died from plague, but from a form of streptococcic infection.

(8) *Portsmouth.*—Three children were admitted about October 16th to the Portsmouth Isolation Hospital with illness resembling enteric fever, attended with pneumonic symptoms and presenting some glandular enlargements. Material taken from each of the patients was forwarded to the Board's bacteriologist for examination, but in each case the report was negative as regards plague.

(9) *Tonbridge.*—Early in November, a medical practitioner consulted the Medical Officer of Health for the district as to a patient, a young woman, who was suffering from an illness characterised by feverishness, with swelling and tenderness of the cervical glands; for which illness no definite cause could be assigned. Material was taken from the patient, and sent for examination to Dr. Klein, who reported that his investigation negatived a diagnosis of plague.

As has been said, in all of the above-mentioned cases, which at first were suspected to be plague, and which were subsequently submitted to scientific scrutiny, no evidence was found to confirm the earlier suspicions.

The facts, however, show that the medical profession has been on the alert; watching, indeed, for those mild and anomalous cases which elsewhere have been stated to appear as forerunners

of epidemic plague, and which when unnoticed and undealt with enable the disease to gain, unobserved, a firm footing in a locality.

(b) *Ship-borne Plague and Suspected Plague in Ports of England and Wales.*

There was a definite increase during 1900, as compared with 1899, in the number of instances in which plague was suspected to have occurred on board ships arriving in ports of England and Wales from plague-infected countries abroad. This increase was perhaps to some extent due to extra care and vigilance exercised by port sanitary authorities in dealing with arrivals from infected ports; in any case, it may be regarded as evidence of the alertness of the officials who allowed no case to pass in which the smallest suspicion as to plague had arisen.

Altogether 23 ships were reported to the Board as having suspected plague on board on their arrival in this country. But in only four instances was the diagnosis confirmed by bacterioscopic investigations. Of these four, two had relation with the port of London, one with Liverpool, and one with the Tyne port. The facts as to them may be briefly summarised as follows:—

(1) S.S. *Rome.*—On July 3rd, 1900, the P. & O. Company's s.s. *Rome* arrived in the Thames, having sailed from Sydney on May 19th, and having called at Colombo and Aden. At the latter port four natives from Bombay joined the *Rome*, having been brought to Aden from Bombay on board the s.s. *Egypt*, to which ship reference will be made further on. These natives, it is alleged, were duly examined at Bombay before going on board the *Egypt*, and were found to be in good health; they did not land at Aden, being transferred direct from the one vessel to the other. As will be seen later, one of these natives developed plague after arrival in the port of London.

On arrival at the mouth of the Thames all on board were reported to be well, and the surgeon of the *Rome* signed a certificate that every person on board had been, within 12 hours of arrival, inspected and found well; free from any symptom of plague, cholera, or yellow fever. Under these circumstances the vessel was allowed to proceed up the river to the Albert Docks.

On July 4th, the day after arrival in the Docks, three native firemen were removed from the *Rome* to the Seaman's Branch Hospital. Two were suffering from "dysentery" and were discharged cured respectively on July 17th and 19th; the third man had "pleurisy," from which he recovered at the end of July.

On July 12th a member of the crew was admitted to hospital suffering from "enteric fever," and he died on the 14th. He first complained of illness on July 8th. After a post-mortem examination his death was certified as due to "enteritis," but

there appear to have been some doubts as to the true nature of this man's illness.

On July 14th a Goanese member of the *Rome's* crew was admitted to the Seaman's Hospital with high temperature and glandular swelling in the groin. Later on, bacteriological examination of material taken from the inflamed glands proved that the man was suffering from plague; a certificate dated July 27th was given to that effect, and the patient was at once removed to the port hospital at Denton, where he ultimately recovered.

On July 23rd a native member of the crew of the *Rome* died suddenly. A few days previous to this he had slightly lacerated one of his fingers. A post-mortem examination was made, and a certificate was given that he had died owing to a "septic condition of the blood."

At this date, July 23rd, the native crew of the *Rome* was transferred to the *Egypt*, which was also in dock. One of these transferred men, a Goanese, was taken to the Seaman's Branch Hospital on July 26th suffering from illness attended with enlargement of the femoral glands. He was at once removed to the port hospital at Denton, the case being suspected to be one of "Pestis Minor." A bacterioscopic examination by Dr. Klein of material taken from the enlarged glands confirmed the diagnosis of plague. The man, however, ultimately made a good recovery.

Of the above cases of illness two were, it will be observed, proved to be plague. Other two were cases of a rapidly fatal sort, but as to which no satisfactory diagnosis had been established, nor had the aid of bacteriology been sought to determine the nature of the malady.

When the diagnosis of plague had been confirmed by the bacteriologist in the two above-mentioned cases, information was at once sent to the Foreign Office for communication to the Signatory Powers of the Venice Convention.

The *Rome* sailed on July 26th on her return voyage to the East with a new native crew which had been transferred to her from the *Egypt*. The bacteriological confirmation of the diagnosis of plague in a member of the *Rome's* previous crew was not, however, completed till July 27th; consequently this vessel sailed without having been disinfected, no suspicion having been entertained by the Shipping Company that plague had attacked any of the crew. Her first place of call was Gibraltar, which she reached on July 31st. Information having been telegraphed to that port the necessary precautions, as to disinfection, &c., were then carried out there, and no futher development of plague occurred on board the *Rome*. The facts as to this outbreak were investigated on behalf of the Board by Dr. Bulstrode.

On August 19th, 1900, information was received by the Board that a native member of the crew of the s.s. *Egypt*, to which ship the crew of the s.s. *Rome* had previously been transferred, was

found to be suffering from a bubo. The man had been working among the "shore gang" of the P. & O. Company since July 28th. He had been removed on August 18th to the Seaman's Branch Hospital; but on the same day, as suspicion arose that the illness might turn out to be plague, he was taken to the Greenwich Hospital, where he was seen by the Medical Officer of Health for the port of London, by whose orders he was at once removed to the isolation hospital at Denton. On examination the patient was found to be suffering from a large inguinal bubo on the left side, and from a similar smaller swelling in the right groin. In both axillæ there were also enlarged glands. He had some fever —temperature 101·2° F.—on admission. There was, in his case, no history or appearance of venereal disease except a suspicious scar. Material from the bubo and specimen of the patient's blood were submitted to a bacteriological examination by Dr. Klein, but with negative results.

Although the provisional diagnosis of plague had not been in this instance confirmed, active measures were taken with regard to the "shore gang," numbering about 100 men, with whom the suspected patient had been working. They were all stripped and individually submitted to a medical examination. The shed in which they were housed was disinfected. The men were paraded, taken to the baths and thoroughly washed under the superintendence of the officers of the P. & O. Company. On leaving the baths they dressed themselves in clothing which had been just previously passed through a steam disinfector. While the men were being bathed, the shed where they dwelt was again disinfected and all their effects were taken to the disinfector before being returned to them. For the usual period these men were medically inspected night and morning till all danger had passed. Fortunately, not a single suspicious case was detected. Dr. Reece, at the direction of the Board, conferred with Dr. Collingridge, the Port Medical Officer of Health, as to the carrying out of the precautionary measures.

(2) S.S. *Highland Mary*.—On August 27th, 1900, this vessel, with a crew of 36 hands and a single passenger, and carrying a cargo partly composed of tallow and frozen meat, arrived at Liverpool from Buenos Ayres, the voyage having lasted 32 days. On arrival, one of the seamen was found to be suffering from suspected plague, which had attacked him on August 8th. The patient had passed the acute stage of his illness, but there was a suppurating bubo in his right groin and an ulcer over the right tibia. He was removed at once to the port hospital. The *Highland Mary*, which had left Buenos Ayres on July 26th, touched at Las Palmas on August 18th, where part cargo of fruit was taken in. The master stated that during the voyage he had observed rats dying all over the vessel. Investigations made by Dr. Balfour Stewart confirmed the diagnosis of plague, but the opinion was expressed that the patient had ceased to be infective by the time he reached Liverpool. The usual precautions, nevertheless, were taken to avoid any possible spread of the infection. No rats could be caught on board the vessel on its arrival at Liverpool. Metal funnels were placed upon the mooring ropes connecting

the vessel to the dock side, and other precautions were taken to prevent rats creeping across.*

The occurrence of this plague case was notified to the Signatories of the Venice Convention on August 30th as soon as the result of Dr. Balfour Stewart's investigations was made known.

During the discharge of the cargo from the *Highland Mary*, one of the inspectors of the Port Sanitary Authority was present with a view to watch if any dead rats were found, and to see that these were properly dealt with by burning them in the ship's furnace.

(3) S.S. *South Garth.*—This vessel left Rosario on August 7th, 1900, with a cargo of grain, and having on board a crew of 23 hands. She touched at St. Vincent on August 30th, and arrived, on September 12th, 35 days out from Rosario, at King's Lynn, where she discharged her cargo. On September 20th she left King's Lynn in water ballast, and on September 22nd reached South Shields. On September 24th the crew were paid off at North Shields, among them a "donkey-man" who had begun to feel out of sorts about September 20th. On the 25th, after being paid off, he consulted a medical practitioner at South Shields, who diagnosed "malaria," and advised him to proceed to his home. On the 27th the sick man travelled by rail in a through carriage from Newcastle to Cardiff, on his way to Llandaff where his wife resided. On arrival at home he called in a medical man, who ultimately became suspicious as to the nature of his patient's illness, which had been notified as doubtfully one of enteric fever. In consequence he consulted Dr. Pritchard, Medical Officer of Health for Llandaff, and Dr. Walford, Medical Officer of Health for Cardiff. The man was removed, on October 2nd, to the Cardiff Borough Hospital, where he died on October 4th. After a post-mortem examination, the corpse was cremated at Flatholm Island, where is also situated the Cardiff Port Hospital for cholera and plague.

On October 3rd, Dr. Savage, of the Cardiff and County Public Health Laboratory, having made a bacterioscopic examination of material taken from the glandular swelling in this patient's groin, formed the opinion that the case was one of plague. This diagnosis was further established by the results of the post-mortem examination, and by investigations made with further material then obtained. These results were corroborated by Dr. Klein, who made an independent bacterioscopic examination on behalf of the Board. This "donkey-man's" illness was, therefore, undoubtedly plague. All the necessary precautions were taken by the local authorities at Cardiff to prevent the spread of the infection from the case, and happily with complete success.

Dr. Buchanan, on behalf of the Board, visited Cardiff, and conferred with the officers of the Sanitary and Port Authorities as to the precautionary measures.

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* A similar precaution was taken with respect to all vessels suspected to be infected with plague arriving in the port of Liverpool.

Information was sent to the Foreign Office as soon as the diagnosis of plague was confirmed, so that the Signatories of the Venice Convention might be notified.

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Plague and suspected plague in England and Wales in 1900 by Dr. Bruce Low.

When the *South Garth* entered the port of King's Lynn on September 12th the master gave satisfactory replies to the usual questions put to him by the Customs boarding officer, and the ship received pratique. On September 14th, two days later, the third engineer, an Austrian, who had joined the vessel at Rosario, consulted a medical man at Lynn as to illness, which he said began two days before the *South Garth* reached that port. The man's symptoms seeming somewhat anomalous he was recommended for admission to the West Norfolk and Lynn Hospital, where he went next day. Dr. Wedgewood, the medical man in question, is one of the hospital staff, and devoted much pains in his endeavour to ascertain the true nature of the man's illness; and it is stated that the possibility, in this case, of plague was considered before it was known that a true plague case had subsequently been discovered in a member of the same ship's crew. But this engineer never had any glandular swellings, and the case was notified as "typhoid fever." He became very delirious, and was ultimately removed to the isolation block of the hospital. He made a good recovery. The diagnosis in this case was indefinite, and though specimens of blood from the patient were examined by Dr. Klein, the results were negative as regards plague. Still, there remains grave suspicion that this man's illness had been an instance of one of the anomalous forms of plague. Fortunately, neither at King's Lynn, nor at Cardiff, nor at Shields, were any other cases of sickness reported in association with the crew of the *South Garth*, appropriate precautionary measures having been in every instance carried out. Dr. Manby visited King's Lynn to investigate the circumstances attending this suspicious case, and to confer with the local authorities as to preventive measures.

Dr. Buchanan made minute inquiry on behalf of the Board into the history of this ship and the movements of her crew. Rosario had been infected by plague for some time before the *South Garth* arrived at that port. At least one of the crew, a Portuguese Indian, had been on shore for a week; he is said to have frequented some of the lowest parts of Rosario. On the voyage home several of the firemen were off duty for short periods, suffering from what was called "heat stroke." With this exception no illness was observed on board till the engineer took ill on or about September 10th. No dead rats had been found on board this vessel during the voyage.

(4) S.S. *Ben Lomond*.—On the arrival of this vessel in the Thames from the Philippine Islands on October 26th, 1900, one of the engineers on board was found by the London Port Medical Officer to be in a feverish condition, with a large glandular abscess pointing in the region of the groin. No other glands were found enlarged, and there was no evidence of venereal disease. The patient was at once removed to the port hospital, and specimens of the contents of the glandular abscess were sent to Dr. Klein for

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bacterioscopic examination. His report pronounced the disease from which the man was suffering to be of the nature of plague. Information to this effeot was at once forwarded by the Board to the Foreign Office for communication to the Signatories of the Venice Convention.

The vessel and all the effects of persons thereon were thoroughly disinfected under the supervision of the officers of the London Port Sanitary Authority, and the usual precautions were taken to prevent the spread of the infection. No rats were found on board, although a special ratcatcher was employed for the purpose. The ship was stated to be "exceptionally free from rats." Only one rat was seen during the voyage from the Philippines, and that was a quite healthy one, which was killed while the ship was at Singapore.

The *Ben Lomond* left Cebu, in the Philippine group, on August 28th, touching at Singapore on September 7th, at Perim on September 30th, at Suez on October 7th, Port Said on October 8th, and at Portland on October 25th; reaching Gravesend, as already stated, on October 28th. Cases of plague were reported at Cebu before the vessel left that island. The engineer's first symptoms of illness began three days after leaving Cebu, and he was seen by a medical man at Singapore on September 7th, but no diagnosis of plague was then made. The symptoms at first were entirely local, and it was not until about the 15th of October that the man had to go off duty. The case may therefore be regarded as having been one of chronic ambulant plague. It is worth mention that this man's illness was not reported on the ship's arrival at Portland, nor on arrival in the Thames. Indeed, the master reported "all well" when the usual questions were put to him. His excuse was that he regarded the case as one of venereal disease, and he had never been in the habit of reporting such cases.

(c) *Precautionary Measures adopted in 1900 to Prevent the Importation and Spread of Plague in England and Wales.*

The possibility of plague being brought to this country by shipping from infected ports abroad engaged the serious consideration of the Medical Department throughout the year. As will be seen further on close touch has been kept with the port and riparian districts of England and Wales, more especially with those more exposed to danger through their trade connections with plague-infected countries.

During the spring months, when plague was apparently increasing in South America, it was deemed advisable to visit and confer with the officials of those port and riparian districts which had trade with Brazil, the Argentine, &c.; and with this view the Board of Customs was requested to furnish the Medical Department with a list of such ports. This list was received on May 29th, and at once the port survey was commenced. Later in the year, when plague had invaded Glasgow, the Board of Customs supplied,

at this Board's request, another list giving the port and riparian districts in England and Wales having trade communications with Glasgow. Altogether during the year some 57 port and riparian districts were visited by the Board's medical inspectors.

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Plague and suspected plague in England and Wales in 1900 by Dr. Bruce Low

In view of the importance which attaches to the concern of rats in the diffusion of plague, and with the object of obtaining information as to the best means for destroying these rodents on a large scale, Dr. Theodore Thomson was instructed to proceed to Paris during the summer to study the method proposed by M. Danysz for destroying rats wholesale by feeding them with artificial cultures of a pathogenic microbe which is not injurious to human beings. The result of Dr. Thomson's inquiries, however, tended to doubt whether this method, as carried out so far can be relied upon to effect its intended purpose with certainty.*

A supply of Haffkine's prophylactic fluid was kept in readiness for distribution in the event of need for its use arising; and the arrangements made in the previous year were continued, by which material, forwarded to the Board by any Medical Officer of Health, from a suspected plague case would be bacteriologically examined by an expert appointed by the Board for this purpose.

The following printed memoranda were drawn up by the Medical Officer and sent to every Sanitary Authority in England and Wales for their information :—

(1) General memorandum on proceedings which are advisable in places attacked or threatened by epidemic disease.

(2) Memorandum on plague, containing :—

(*a*) Administrative considerations.

(*b*) Symptoms of plague.

(3) Directions for obtaining and forwarding for bacterioscopic examination material from suspected plague cases.

During September an Order under the epidemic regulations was issued by the Board making compulsory the notification of plague to the Board and to the Local Authority. A copy of this Order with an explanatory letter was sent to every Sanitary Authority in England and Wales.

During the autumn an important conference was held at Whitehall between representatives of the Board and those of the Admiralty, War Office, and the Port of London Sanitary Authority,

* Recent experiences at San Francisco and at Cape Town gave more favourable results of the Danysz method; but, on the other hand, Dr. Ashburton Thompson, Chief Medical Officer to the Government of New South Wales, says it was tried at Sydney in 1900 "without any useful results being obtained.' Dr. Collingridge also made experiments with it in the London Docks, "but no results were observable, and to this extent the experiment was unsatisfactory." It would seem, therefore, that further tests are necessary before reliance can be placed upon the Danysz method.

[illegible]

[illegible] Ports [illegible] Thomson.

[illegible] mainly on [illegible] Inspectors of the Board in the [illegible] with a view to [illegible] Local Authorities of these [illegible] on them under [illegible] and persons on ship- [illegible] These visits were made [illegible] years 1897, 1898, 1899 and [illegible] on the appearance [illegible] or more seaports in [illegible] on the Board becoming aware [illegible] an Inspector was sent to every sea- [illegible] known to have trade with the [illegible] ascertaining the organisation and [illegible] the Local Authorities for dealing [illegible] as well as to take cognisance of measures [illegible] wholesomeness of vessels in these districts [illegible] persons on ship-board. Shortcomings of [illegible] these respects observed by the Inspector, [illegible] pointed out by him in the course of [illegible] or to their officials: and, in [illegible] instances, the attention of the authority was subsequently [illegible] to the more serious defects in their administration by [illegible] from the Board. In this way 40 Port Sanitary districts, [illegible] Urban Riparian districts, and 3 Rural Riparian districts were inspected during the four years 1897–1900. Most of these districts were inspected on two or three occasions during this period, a few were inspected once only: the occasions of inspection being governed largely by consideration of the possibilities of ship-borne plague reaching particular districts from the localities where, from time to time, this disease made its appearance.

For this reason also, the Port and Riparian districts inspected are fewer than those visited in the (Cholera) Port and Riparian Sanitary Survey in 1893-4, which was not limited to seaports having trade with infected places. In the Cholera Survey, 60 Port Sanitary districts, 31 Urban Riparian districts, and 6 Rural Riparian districts were inspected: the total number of districts inspected being, therefore, 97, as against 57 inspected in the course of the Plague Survey, of which account is here given.

In the table which follows a brief statement is furnished as to the condition of each district in respect of the matters of chief importance in Port and Riparian administration. These matters are the inspect[illegible]

properly equipped hospital accommodation for the infectious sick; the provision of an efficient disinfecting apparatus; the provision of mortuary accommodation; and the adoption of regulations under Section 125 of the Public Health Act 1875. The quality of the general administration by each Local Authority, as evidenced by the means provided for the proper discharge of Port or Riparian duties and by the degree of thoroughness with which their duties were found to be performed, is also stated in the table.

Action taken by the Local Authority subsequent to the Inspector's visits, when information of this sort has been available, is indicated by notes in italics.

No. 20.

App. A, No. 20.
General Sanitary Administration in certain Ports and Riparian districts; by Dr. Theodore Thomson.

General Sanitary Administration in Certain Ports and Riparian Districts: by Dr. Theodore Thomson.

The facts recorded under this head are based mainly on information acquired by Medical Inspectors of the Board in the course of visits made by them to several districts with a view to ascertaining the manner in which the Local Authorities of these districts were discharging the duties incumbent on them under the Public Health Acts, as regards vessels and persons on shipboard coming within their jurisdiction. These visits were made from time to time during the four years 1897, 1898, 1899 and 1900: and, for the most part, were instituted on the appearance of plague in places having trade with one or more seaports in England and Wales. Immediately on the Board becoming aware of such occurrence of plague, an Inspector was sent to every seaport in England and Wales known to have trade with the infected place, with the view of ascertaining the organisation and the means at the disposal of the Local Authorities for dealing with ship-borne plague, as well as to take cognisance of measures intended to secure the wholesomeness of vessels in these districts and the well-being of persons on ship-board. Shortcomings of authorities in any of these respects, observed by the Inspector, were in all instances pointed out by him in the course of his visit to the Local Authority or to their officials: and, in many instances, the attention of the authority was subsequently directed to the more serious defects in their administration by letter from the Board. In this way 40 Port Sanitary districts, 14 Urban Riparian districts, and 3 Rural Riparian districts were inspected during the four years 1897–1900. Most of these districts were inspected on two or three occasions during this period, a few were inspected once only: the occasions of inspection being governed largely by consideration of the possibilities of ship-borne plague reaching particular districts from the localities where, from time to time, this disease made its appearance.

For this reason also, the Port and Riparian districts inspected are fewer than those visited in the (Cholera) Port and Riparian Sanitary Survey in 1893–4, which was not limited to seaports having trade with infected places. In the Cholera Survey, 60 Port Sanitary districts, 31 Urban Riparian districts, and 6 Rural Riparian districts were inspected: the total number of districts inspected being, therefore, 97, as against 57 inspected in the course of the Plague Survey, of which account is here given.

In the table which follows a brief statement is furnished as to the condition of each district in respect of the matters of chief importance in Port and Riparian administration. These matters are the inspection of vessels; the provision of sufficient and

properly equipped hospital accommodation for the infectious sick; the provision of an efficient disinfecting apparatus; the provision of mortuary accommodation; and the adoption of regulations under Section 125 of the Public Health Act 1875. The quality of the general administration by each Local Authority, as evidenced by the means provided for the proper discharge of Port or Riparian duties and by the degree of thoroughness with which their duties were found to be performed, is also stated in the table.

Action taken by the Local Authority subsequent to the Inspector's visits, when information of this sort has been available, is indicated by notes in italics.

App. A, No. 30.

General Sanitary Administration in certain Ports and Riparian districts; by Dr. Theodore Thomson.

ADMINISTRATION of certain PORT SANITARY DISTRICTS and
1897, 1898, 1899,

Statements in *Italics* refer to action taken by

Sanitary Authority.*	General Administration.	Inspection of Vessels.	Hospital Provision.
1. Berwick U.R.	Moderate ..	Only a small proportion inspected. *"All ships coming into the port are inspected" (Medical Officer of Health Annual Report for 1900).*	Wooden hospital with two wards, each with four beds. Negotiations proceeding for the erection of a permanent hospital.
2. River Blyth P.	Satisfactory ..	Efficient	Temporary hospital with accommodation for 16 patients: number of wards, four.
3. River Tyne P.	Good	Efficient for the most part; but has occasionally been unsatisfactory.	Floating hospital with 30 beds: number of wards, six.
4. Sunderland P.	Fair	Fair	Floating hospital, structurally defective. It was proposed to remove cases of plague on board ship to the Borough Isolation Hospital on shore.
5. Hartlepool P.	Satisfactory ..	Efficient	P. S. A. have the use, conjointly with the Boroughs of Hartlepool and West Hartlepool, of a hospital with 35 beds.
6. River Tees P.	Good	Efficient	Floating hospital, with 25 beds: four wards.
7. Hull and Goole P.	Good	Efficient	Hospital, with 30 beds, in Sculcoates parish, four miles from Hull docks. The Goole Urban Hospital available for port cases at Goole.
8. Grimsby P. ..	Fair	Fair	No port hospital. The Borough of Grimsby has two hospitals: one estimated to accommodate 40 cases, the other estimated to accommodate 35.
9. King's Lynn P.	Lax	Inefficient .. .. *Inspector of Nuisances instructed by the Port Authority to devote more time to inspection of shipping.*	Hospital, with 12 beds, about a mile from the docks.
10. Yarmouth P...	Satisfactory ..	Efficient	The Borough Hospital is available for port purposes.

* P. signifies Port Sanitary Authority. U.R. signifies Urban Riparian

of certain RIPARIAN DISTRICTS in ENGLAND and WALES in and 1900.

APP. A, No. 20.

General Sanitary Administration in certain Ports and Riparian districts; by Dr. Theodore Thomson.

Authorities in sequence to visit of Inspector.

Disinfecting Apparatus.	Mortuary.	Date of approval by L.G.B. of Regulations under Sec. 125 of P.H. Act, 1875.	Visits by the Board's Medical Inspectors.
Portable dry-heat apparatus ..	Provided at the hospital	None	1899 : 1900.
None	P.S.A. have the use of the South Blyth U.D.C.'s Mortuary. There is also a mortuary at the Port Hospital.	Jan. 24, 1898 ..	1899 : 1900.
Steam disinfecting chamber ..	Provided at the floating hospital.	Feb. 16, 1886 ..	1897 : 1899 : 1900.
None. P. S. A. have the use of the steam disinfecting chamber at the Borough Hospital.	None. There is a mortuary at the Borough Hospital.	None	1899 : 1900.
Steam disinfecting chamber at hospital.	Provided at hospital ..	June 1, 1886 ..	1899 : 1900.
The steam disinfecting chamber belonging to the Borough of Middlesborough available for port purposes.	Provided at hospital. There is also a mortuary belonging to the Borough of Middlesborough near the docks.	Dec. , 1893 ..	1899 : 1900.
Steam disinfecting chamber at Sculcoates Hospital.	Provided at hospital ..	Dec. , 1893 ..	1897 : 1899 ; 1900.
There is a steam disinfecting chamber at each of the Borough Hospitals.	Provided at each of the Borough Hospitals.	None	1900.
Steam disinfecting chamber ..	It is proposed to use a room at the disinfecting station as a mortuary.	None	1899 : 1900.
Steam disinfector at the Borough Hospital available for port purposes	Provided at Gorleston near the mouth of the river.	None	1899 ; 1900.

Sanitary Authority. R.R. signifies Rural Riparian Sanitary Authority.

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General Sanitary Administration in certain Ports and Riparian districts; by Dr. Theodore Thomson.

ADMINISTRATION of certain PORT SANITARY DISTRICTS and 1897, 1898, 1899,

Sanitary Authority.	General Administration.	Inspection of Vessels.	Hospital Provision.
11. Lowestoft P...	Satisfactory ..	Fair .. .. *An Assistant Inspector of Nuisances appointed to aid in inspection of shipping.*	The Borough Hospital, about half a mile from the inner harbour, available for port purposes.
12. Ipswich P. ..	Lax	Inefficient	Floating hospital with two wards.
13. London P. ..	Very good ..	Efficient	At Denton. Seven wards in three ward-blocks. Total accommodation, 17 beds.
14. Dover U.R. ..	Bad	Very inadequate ..	At the Urban District Hospital, 1½ miles from the docks.
15. Newhaven P.	Very unsatisfactory.	Unsatisfactory ..	None. The Newhaven Urban District Council possess an unsatisfactory hospital, 1¼ miles from the harbour.
16. Portsmouth P.	Unsatisfactory	Inadequate.. ..	None .. .. *An Admiralty hulk, the Edgar, placed at the disposal of the Port Authority during the continuance of Plague in Europe.*
17. Southampton P.	Good	Efficient	Floating hospital with three wards and 30 to 35 beds.
Poole P. ..	Moderate ..	Moderate	Partly permanent, partly temporary. Accommodation for 15 cases.
19. Bridport U.R.	Fair	Fair	Wooden hospital near the harbour, with accommodation for six cases. Also a permanent hospital 2¼ miles from harbour.
20. Lyme Regis U.R.	Bad	None .. .. *Medical Officer of Health and Inspector of Nuisances instructed by the Authority to inspect shipping.*	A room in a building on the Quay, formerly used as a workhouse, converted into a ward for two patients. The building is not equipped for hospital purposes.
21. Exeter P. ..	Moderate ..	Moderate .. .. *Assistant Medical Officer of Health, resident at Exmouth appointed.*	None .. .. *Hospital ship provided with two wards, each to accommodate one case; moored off Exmouth.*
22. Teignmouth P.	Unsatisfactory	Very fair	Imperfect isolation accommodation for five cases.
23. Dartmouth P.	Satisfactory ..	Very fair	Floating hospital, with two wards, each fitted up for two cases. Further accommodation available on board if required.
24. Plymouth P...	Good	Efficient	Floating hospital, about 1½ miles from docks, with accommodation for 50 or 60 cases.

of certain RIPARIAN DISTRICTS in ENGLAND and WALES in and 1900—*continued.*

Disinfecting Apparatus.	Mortuary.	Date of approval by L.G.B. of Regulations under Sec. 125 of P.H. Act, 1875.	Visits by the Board's Medical Inspectors.
Steam disinfecting chamber at the Borough Hospital, available for port purposes.	A properly equipped mortuary provided on the beach. Also a mortuary at the Borough Hospital.	Sept. 28, 1888 ..	1899 : 1900.
Steam disinfecting chamber at the Borough Hospital available for port purposes.	Provided at the Borough Hospital.	None	1900.
Steam disinfecting chamber at hospital.	Provided at hospital ..	Jan. 29, 1893 ..	1897 : 1899 : 1900.
Steam disinfecting chamber at hospital.	Provided at hospital ..	None	1900.
None	None. The Newhaven Urban District Council possesses a mortuary.	None	1900.
None. But a steam disinfecting chamber belonging to the Urban Authority is available for port purposes.	None. The Urban authority possesses a mortuary some distance from the docks.	None	1897 : 1899 : 1900.
Steam disinfecting chamber ..	Provided on board the floating hospital.	None	1897 : 1899 : 1900.
None	Provided near the hospital.	None	1900.
Hot-air apparatus	Provided at the permanent hospital.	None	1900.
None	None	None	1900.
None. But a steam disinfecting chamber belonging to the city of Exeter is available for port purposes.	None	None	1899 : 1900.
None	None	None	1900.
Sulphur "fumigation" chamber on board the floating hospital. *The Authority have decided to provide a steam disinfector on board the floating hospital.*	Provided on board the floating hospital.	None	1900.
None. Steam disinfecting chamber, belonging to the Urban Authority, available for port purposes.	Provided on board the floating hospital.	None	1898 : 1899 : 1900.

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General Sanitary Administration in certain Ports and Riparian Districts; by Dr. Theodore Thomson.

ADMINISTRATION of certain PORT SANITARY DISTRICTS and 1897, 1898, 1899,

Sanitary Authority.	General Administration.	Inspection of Vessels.	Hospital Provision.
25. Fowey P. ..	Fair	Very fair .. .. *Two assistant Medical Officers of Health appointed*	Galvanised iron building, about 1 mile from the Boarding Station, with accommodation for four cases.
26. Falmouth and Truro P.	Bad	Very inefficient ..	Wooden building, about one mile from docks, with two wards, each fitted with three beds.
27. Padstow P. ..	Fair	Satisfactory ..	An isolated house; one room fitted up as a ward, with two beds.
28. Barnstaple P.	Satisfactory ..	Fair	Floating hospital moored off Instow, with four wards, having a total accommodation of 8-10 beds.
29. Bridgwater P.	Bad . .	Inefficient	None .. .. *Arrangement has been made that cases of infectious disease will be taken to the Cardiff Port Sanitary Authority's Hospital on Flatholm Island.*
30. Bristol P. ..	Good	Efficient	Wooden hospital on shore at Avonmouth, with eight beds. Hospital ship, the "Margarida," moored in the Avon, with accommodation for 14 cases.
31. Gloucester P.	Satisfactory ..	Fair	Two wooden hospitals; each with one ward.
32. Newport P. ..	Good	Efficient	Wooden building. Arrangement also with Cardiff P. for the use of the latter's hospital on Flatholm Island.
33. Cardiff P. ..	Good	Efficient	Two hospitals on Flatholm Island; one hospital with two wards, each with six beds; the other hospital with four beds.
34. Barry P. ..	Good	Efficient	Arrangement made with Cardiff P. for the use of the latter's hospital on Flatholm Island.
35. Swansea P. ..	Fair	Fair .. .. .. *Inspecting staff increased by appointment of an additional Assistant Inspector of Nuisances.*	None. The Urban Hospital is available for port purposes.
36 Llanelly R.R.	Bad	None .. .. .. *Assistant Inspector of Nuisances appointed, and instructed by the Authority to inspect all shipping.*	Galvanised iron building, about half a mile from docks, with one ward.

of certain RIPARIAN DISTRICTS in ENGLAND and WALES in and 1900—*continued.*

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General Sanitary Administration in certain Ports and Riparian districts; by Dr. Theodore Thomson.

Disinfecting Apparatus.	Mortuary.	Date of approval by L.G.B. of Regulations under Sec. 125 of P.H. Act, 1875.	Visits by the Board's Medical Inspectors.
None	Provided at hospital ..	Oct. 25, 1888 ..	1899 : 1900.
None	None	None	1899 : 1900.
None	None	None	1899 : 1900.
None .. .. *A steam disinfecting chamber, belonging to the Urban Authority, has been made available for port purposes.*	Provided on board the floating hospital.	None .. .	1899 : 1900.
None	None	None	1899 : 1900.
None. But a steam disinfecting chamber, belonging to the Urban Authority, is available for port purposes.	Provided in connection with each of the hospitals.	Dec. 31, 1888 ..	1897 : 1899 : 1900
None. But a steam disinfecting chamber, belonging to the Urban Authority, is available for port purposes.	Provided at each of the hospitals.	None	1897 : 1899 : 1900.
None. But a steam disinfecting chamber, belonging to the Urban Authority, is available for port purposes.	Provided at hospital ..	Jan. 3, 1900 ..	1897 : 1899 ; 1900.
Steam disinfecting chamber on Flatholm.	Provided on Flatholm Island.	Feb. 24, 1896 ..	1897 : 1899 : 1900.
None. But a steam disinfecting chamber, belonging to the Urban Authority, is available for port purposes; and the Port Authority have also arranged with Cardiff P. for the use of their steam disinfector on Flatholm Island.	None. But a mortuary belonging to the Urban Authority is available for port purposes; and the Port Authority have also arranged with Cardiff P. for the use of their mortuary on Flatholm Island.	June 22, 1894 ..	1897 : 1899 : 1900.
None. But a steam disinfecting chamber, at the Urban Hospital, is available for port purposes.	None. But a mortuary belonging to the Urban Authority is available for port purposes.	None	1897 : 1899 : 1900.
None. The Authority have occasionally borrowed a portable steam disinfector belonging to the Llanelly Urban Authority.	None	None	1899 : 1900.

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General Sanitary Administration in certain Ports and Riparian districts; by Dr. Theodore Thomson.

ADMINISTRATION of certain PORT SANITARY DISTRICTS and 1897, 1898, 1899,

Sanitary Authority.	General Administration.	Inspection of Vessels.	Hospital Provision.
37. Llanelly U.R.	Bad	Inefficient .. .. *Assistant Inspector of Nuisances appointed, and instructed by the Authority to inspect shipping.*	None .. ..
38. Kidwelly, U.R.	None	None .. .. .. *Inspector of Nuisances instructed by the Authority to inspect all vessels arriving in the district.*	None .. .. *The "Quay house" to be used as an isolation hospital when required.*
39. Milford P. ..	Unsatisfactory	Inefficient	An old brig; beached at a spot 5 miles from Milford docks by land, and 3¼ miles by sea from the mooring station.
40. Ynyscynhaiarn U.R.	Very bad ..	None .. .. .. *Periodical inspection of vessels arriving at Port Madoc by the Inspector of Nuisances.*	None. The cottage, noted in the 1893 survey as hired for hospital purposes, is now let for habitation.
41. Holyhead U.R.	Bad	Hardly any ..	None. Arrangements made for the use of an isolation ward with two beds, belonging to a private hospital on Salt Island.
42. Beaumaris P.	Fair	Fair	Hospital ship with four beds
43. Conway R.R.	None	None	None .. ..
44. St. Asaph R.R.	None	None	None .. ..
45. Chester P. ..	Satisfactory ..	Fair	Building at Mostyn with four beds.
46. Manchester P.	Good	Satisfactory ..	None. But the Liverpool Port Sanitary Authority isolate cases of cholera, yellow fever, and plague detected by them on board vessels bound for Manchester. In addition, it has been arranged that the Liverpool Port Sanitary Authority shall isolate cases of small pox detected by them on Manchester-bound vessels; that Wirral Joint Hospital Board, Runcorn U.D.C., and the Boroughs of Widnes and Warrington shall isolate cases of infectious disease detected on ships in their respective neighbourhoods; and that the Borough of Salford shall isolate cases of infectious disease from any part of the ship canal.

of certain RIPARIAN DISTRICTS in ENGLAND and WALES in and 1900—*continued.*

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General Sanitary Administration in certain ports and Riparian districts; by Dr. Theodore Thomson.

Disinfecting Apparatus.	Mortuary.	Date of approval by L.G.B. of Regulations under Sec. 125 of P.H. Act, 1875.	Visits by the Board's Medical Inspectors.
Portable steam disinfector ..	None	None	1899 : 1900.
None	None	None	1900.
None	Provided on hospital ship.	None	1900
None	None	None .. .	1900.
None	.. ..	None	1899 : 1900.
None	None. But the Port Authority have arranged with the Beaumaris Urban Authority for the use of their mortuary.	July 20, 1894 ..	1900.
None	None	None	1900.
None	None	None	1900.
None	Provided at hospital ..	Oct. 26, 1894 ..	1900.
None. But the Port Authority have made arrangements with Liverpool and Salford for the use of their steam disinfecting chambers.	None. But the mortuaries at the several hospitals, for the use of which the Port Authority have made arrangements, are available for port purposes.	Oct. 6, 1898 ..	1899 : 1900

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ADMINISTRATION of certain PORT SANITARY DISTRICTS and 1897, 1898, 1899,

Sanitary Authority.	General Administration.	Inspection of Vessels.	Hospital Provision.
47. Liverpool P. ..	Good	Efficient	Corrugated iron hospital at New Ferry on the Cheshire bank of the Mersey, with two wards, each ward containing 12 beds. This hospital is reserved for exotic disease. Cases of other infectious diseases sent to one of the City hospitals for infectious disease.
48. Preston P ..	Satisfactory ..	Efficient	Galvanised iron hospital near the docks, with two wards. Total number of beds, 14. Reserved for exotic disease; other infectious diseases taken to the fever hospital of the Royal Infirmary, Preston.
49. Fleetwood P.	Fair	Inadequate.. ..	Corrugated iron building near the docks.
50. Lancaster, P.	Lax	Fair	Wooden structure with two wards and a nurses room, about a mile from Glasson dock. Is not fitted up, and has no drainage nor water supply.
51. Morecambe U.R.	None .. .. *The Urban District Council have expressed their intention to discharge their duties as a riparian authority.*	None.. .. .. *The Inspector of Nuisances to inspect periodically vessels from Dublin and Londonderry, and other vessels "when necessary."*	Hospital, partly permanent and partly temporary, about 2 miles from harbour.
52. Barrow U.R...	Fair	Satisfactory .	Wooden hospital, with one ward of four beds, on Sheep Island.
53. Millom U.R...	Satisfactory ..	Fair	Wooden hospital, with two ward blocks.
54. Whitehaven U.R.	Satisfactory ..	Satisfactory ..	Hospital, about a mile from the docks, with two ward-blocks. Accommodation for 16 cases.
55. Workington P.	Very fair ..	Satisfactory ..	Hospital with five beds ..
56. Maryport U.R.	Fair	Moderate	Hospital about three-quarters of a mile from docks, with two wards. Accommodation for seven cases.
57. Holme Cultram U.R.	Almost nil ..	Very inefficient .. *Assistant Medical Officer of Health appointed.*	None.. .. ..

of certain RIPARIAN DISTRICTS in ENGLAND and WALES in and 1900—*continued.*

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General Sanitary Administration in certain Ports and Riparian districts; by Dr. Theodore Thomson.

Disinfecting Apparatus.	Mortuary.	Date of approval by L.G.B. of Regulations under Sec. 125 of P.H. Act, 1875.	Visits by the Board's Medical Inspectors.
None. But the steam disinfecting chambers belonging to the City, are available for port purposes.	Provided at the Port Authority's hospital.	None	1897 : 1899 : 1900.
None. A hot-air apparatus, belonging to the Urban Authority, available for port purposes.	Provided at the Port Authority's hospital.	April 12, 1894 ..	1900.
None. But a steam disinfecting chamber belonging to the Urban Authority, available for port purposes.	Provided at the hospital	Nov. 24, 1899 ..	1899 : 1900.
None. But a steam disinfector belonging to the Borough of Lancaster is available for port purposes.	Provided at hospital; is a badly constructed wooden erection.	Sept. 12, 1900 ..	1899 : 1900.
Steam disinfecting chamber about half a mile from harbour.	Two mortuaries; one at hospital, one in the town.	None	1900.
Apparatus for "fumigation" with sulphur.	Provided at hospital ..	July 20, 1894 ..	1899 : 1900.
Steam disinfecting chamber at hospital.	Provided at the hospital	Nov. 21, 1894 ..	1899 : 1900.
Steam disinfecting chamber at hospital.	Provided at the hospital	May 16, 1900 ..	1899 : 1900.
None	Provided at the hospital	None	1899 : 1900.
Steam disinfecting chamber at hospital.	Provided at the hospital	July 20, 1894 ..	1899 : 1900.
None	None	None	1899 : 1900.

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General Sanitary Administration in certain Ports and Riparian districts: by Dr. Theodore Thomson.

General Administration.

The quality of general administration in the several districts comprised in the foregoing table may conveniently be indicated by three classes, of which Class A includes Authorities whose administration is described as "good" or "satisfactory"; Class B includes those whose administration is termed "fair" or "moderate"; while Class C includes those whose administration is referred to as "lax," "unsatisfactory," "bad," or "none." Of the 57 districts dealt with in the table, 23 are in Class A; 14 in Class B; and 20 in Class C. It is satisfactory to note that most of the seaports in the list with a large amount of traffic are well organised and come within Class A. The most notable exceptions in this respect among the larger seaports are Portsmouth, which is classed as "unsatisfactory"; Newhaven, which is "very unsatisfactory"; Dover and Holyhead, which are "bad." The large amount of passenger traffic from the Continent to Dover and Newhaven, and from Dublin to Holyhead, renders mal-administration by the Authorities of these places matter of serious concern.

Rather more than one-third of the districts visited are in Class C; and the Authorities of four of these districts were found at the date of inspection to be entirely neglecting their duties as Riparian Authorities. It is true that many of the districts ranked in Class C are places with no great amount of trade by sea, and that the probability of importation of plague into these seaports is correspondingly small. The risk, however, exists; and the Authorities of these districts, accordingly, should be in a position to deal promptly and efficiently with sea-borne plague, as well as to discharge their other duties under the Public Health Acts in respect of shipping coming within their jurisdiction.

Comparison of these data with like data afforded by the Cholera Survey in 1893–4, goes to show that there has been improvement in the administration of port and riparian districts since the time of that survey. The comparison cannot be an exact one; for a considerable number of districts inspected in the course of the Cholera Survey were not inspected during the Plague Survey, while a few districts inspected in the Plague Survey were not inspected in the Cholera Survey. But 50 of the districts included in the Plague Survey were also included in the Cholera Survey; and, as regards these, the following tabular statement shows the quality of the general administration at the time of each survey:—

Quality of Administration.	Plague Survey, 1897–1900.	Cholera Survey, 1893–4.
Class A	21	15
Class B	13	14
Class C	16	21
All Classes	50	50

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General Sanitary Administration in certain Ports and Riparian districts; by Dr. Theodore Thomson.

The administrative improvement indicated by these figures is expressed by increase of the number of districts in Class A, and diminution of those in Class C. Prominent among the districts in which there has been marked improvement are the following :— the River Blyth Port Sanitary District, formerly "not very satisfactory," now "satisfactory"; Dartmouth Port Sanitary District, formerly "bad," now "satisfactory"; Southampton Port Sanitary District, formerly "improving," now "good"; Workington Port Sanitary District, formerly "unsatisfactory," now "very fair"; and Yarmouth Port Sanitary District, formerly "extremely inefficient," now "satisfactory." There are, however, instances of districts which have fallen from Class B to Class C. But it is satisfactory to note that change has, in the main, been for the better.

Inspection of Vessels.

If, as regards the extent and quality of inspection of vessels, a classification be adopted similar to that adopted in respect of the quality of general administration, 20 districts fall within Class A, 17 districts within Class B, and 20 districts within Class C. In view of the importance attaching to systematic and careful inspection of shipping, particularly as a means of detecting cases of plague on ship-board, the large proportion of districts in Class C is a serious matter. Failure or shortcoming in this respect is especially serious in sea-ports of the importance of Dover, Newhaven, and Holyhead, where inspection of vessels is described as "very inadequate," "unsatisfactory," and "hardly any," respectively. It would be difficult to comment too strongly on this reprehensible neglect of a duty so important to the public health by the authorities of these places.

Many of the districts in Class C have but little trade by sea; which, however, affords no reason for neglect of systematic inspection of such vessels as arrive at ports or places within these districts. It is satisfactory to note that in some districts there has been improvement as regards inspection of vessels subsequent to visits by Inspectors of the Board.

Comparison between the facts noted in this survey regarding inspection of vessels and those given in the account of the Cholera survey is, as regards the 50 districts included in both surveys, afforded by the following tabular statement.

Extent and quality of inspection.	Plague Survey, 1897-1900.	Cholera Survey, 1893-4.
Class A	18	14
Class B	16	14
Class C	16	22
All Classes	50	50

From these figures it appears that the extent and quality of inspection of shipping, as ascertained in the course of the Plague Survey, although far from satisfactory, nevertheless shows improvement on what was found to obtain at the time of the Cholera Survey.

Hospital Provision for Infectious Disease.

Of the 57 districts included in the table, 9 had, at the date of most recent inspection, neither made provision for the isolation of cases of infectious disease arriving by sea, nor, in the absence of hospital accommodation of their own, made arrangements with neighbouring authorities for the use of hospitals belonging to the latter. Of these 9, 4 have since provided or arranged for hospital accommodation. The 5 districts which still are without arrangements for the isolation of cases of infectious sickness coming by sea, are the Urban Districts of Holme Cultram, Llanelly, and Ynyscynhaiarn; and the Rural Districts of Conway and St. Asaph. But it will be seen from the table that, in the districts which have either provided hospitals themselves or made arrangements for the use of those of neighbouring authorities, there is great variation in respect of the quality and also the amount, relatively to the needs of the district, of the accommodation provided. In several instances there is much room for improvement in both these respects.

Disinfecting Apparatus.

Of the 57 districts, 32 were found either to possess or to have made arrangements for the use of an efficient apparatus for disinfection by steam. Three districts, viz., Preston Port Sanitary District, and the Urban Districts of Berwick and Bridport, possessed only a dry-heat apparatus: two districts, viz., Dartmouth Port Sanitary District and Barrow Urban District, had but a chamber for "sulphur fumigation": while 20 districts had neither provided themselves with any form of disinfecting apparatus nor had made any arrangement for the use of a disinfecting apparatus belonging to a neighbouring authority. These 20 districts are the following: the Port Sanitary Districts of Beaumaris, River Blyth, Barnstaple Bridgwater, Chester, Falmouth, Fowey, Milford, Newhaven, Padstow, Poole, Teignmouth, and Workington: the Urban Districts of Holme Cultram, Holyhead, Kidwelly, Lyme Regis, and Ynyscynhaiarn: and the Rural Districts of Conway and St. Asaph. Of these 20 districts, one, viz. Barnstaple Port Sanitary District, has since arranged that a steam disinfecting apparatus belonging to the Urban Authority shall be available for port purposes.

It will be seen, therefore, that although more than half of the districts surveyed are either provided with an efficient disinfecting chamber or have made arrangements with a neighbouring district for the use of such, yet there are many without any disinfecting chamber available and others with provision of this sort that cannot be regarded as efficient. It is true that our great ports are satisfactorily equipped in this respect: but there are, among the port and riparian districts not provided with efficient disinfecting apparatus, several that have a large amount of cargo or passenger traffic, or of both.

APPENDIX B.

No. 1.

App. B, No. 1.

On Behaviour of Specific Microbes in relation with Cereal Products; by Drs. Klein and Houston.

REPORT on the BEHAVIOUR of SPECIFIC MICROBES in relation with CEREAL PRODUCTS; by DRS. E. KLEIN and A. C. HOUSTON.

In last year's report it was shown that several kinds of imported grain (wheat, oats, and rice) are apt to contain, besides certain seemingly harmless bacteria, so to speak, proper to them, bacillus coli and coli-like organisms, and as well, spores of the virulent bacillus enteritidis. The presence of these extraneous micro-organisms we regarded as probably due to admixture with the grain of surface soil, dust, &c., at the place where it grew, or during its collection and transmission.

Also it was shown that cereal products such as wheat flour and oatmeal can contain coli-like microbes and the spores of the virulent bacillus enteritidis, derived probably, as in the case of grain, from the surface soil and from dust.

This year wheat flour, oatmeal, and rice flour have been tested as to their capacity for conserving certain definite microbes purposely added to them. Our object was to ascertain whether pathogenic microbes accidentally gaining access to cereal products can for any length of time survive in them, and can thus confer on food materials, of which these cereal products are ingredients, sustained infective power. It is true that most of the materials in question are subjected in the process of their preparation to various degrees of heat, and that they may be thought of as generally sterilized. Nevertheless, it is an every day experience that, in cooking, cereal products are not uniformly throughout their substance exposed to the same degree of heat; so that while in some portions they no doubt have been thoroughly sterilised, in others the degree of heat to which they have actually been exposed may have fallen short of that required to kill pathogenic bacteria, even such as are non-sporing.

The microbes which we used in our experiments were:—(*a*) the bacillus pyocyaneus; (*b*) the vibrio of cholera; (*c*) the bacillus diphtheriæ; (*d*) the typhoid bacillus; and (*e*) the staphylococcus pyogenes aureus. All these are non-sporing bacteria which, by special methods, can be identified without great difficulty; some by the distinct colouration of their microbic growth, as, for instance, bacillus pyocyaneus and staphylococcus aureus; others by their specific cultural reactions (typhoid bacillus and cholera vibrio); and others again by the results of animal experiment (bacillus diphtheriæ). It was necessary to limit ourselves to microbes which offered a fair chance of identification after being

kept in non-sterile flour water, oatmeal water, and rice water, media which, as we have already shown, may contain at starting a considerable number of microbes of different sort. And, as will be presently seen, our choice in this matter was somewhat fortunate, since, notwithstanding limitation of experiment to wheat flour, oatmeal, and rice flour, and limitation of the microbes tested to five, the amount of work involved was considerable.

The following is a summary of our report :—

SERIES I.—EXPERIMENTS WITH WHEAT FLOUR.

A. *Bacillus of typhoid fever.*

Experiment 1 (Table 1).

Experiment 2 (Table 2).

B. *Bacillus diphtheriæ.*

Experiment 3 (Table 3).

C. *Staphylococcus pyogenes aureus.*

Experiment 4 (Table 4).

Experiment 5 (Table 5).

D. *Vibrio of cholera.*

Experiment 6 (Table 6).

Experiment 7 (Table 7).

E. *Bacillus pyocyaneus.*

Experiment 8 (Table 8).

SERIES II.—EXPERIMENTS WITH OATMEAL.

A. *Bacillus of typhoid fever.*

Experiment 9 (Table 9).

B. *Bacillus diphtheriæ.*

Experiment 10 (Table 10).

C. *Vibrio of cholera.*

Experiment 11 (Table 11)

D. *Bacillus pyocyaneus*

Experiment 12 (Table 12).

SERIES III.—EXPERIMENTS WITH GROUND RICE.

A. *Bacillus of typhoid fever.*

Experiment 13 (Table 13).

B. *Bacillus of diphtheriæ.*

Experiment 14 (Table 14).

C. *Vibrio of cholera.*

Experiment 15 (Table 15).

D. *Bacillus pyocyaneus.*

Experiment 16 (Table 16).

SERIES I.—EXPERIMENTS WITH WHEAT FLOUR.

These experiments were conducted in the following manner:— 1 gramme of unsterilised wheat flour, obtained at a retail shop, was placed in a sterile test tube along with 9 cc. of sterile water. To this was added a big loopful of the growth of the microbe of experiment, taken from the slanting surface of a recent agar culture. The tube was then again plugged, and the contents having been well shaken, was kept at the temperature of the room in a dark cupboard. For control and for comparison, a loopful of the mixture had been taken immediately after infecting the flour water, and used for cultivation. From time to time a definite amount of the mixture was taken from the tube, at the periods stated in the report, and used for cultivation purposes.

A.—*Bacillus of Typhoid Fever and Wheat Flour.*

Experiment 1.

(*a*) The first culture test was made after 24 hours. Thus, one platinum loopful of the flour water, after having been well shaken up, was rubbed over the surface of phenol agar, previously set in a sterile plate dish. On this plate, after incubation for 24 hours at 37° C., there were present many colonies. Some of these, on subjecting them to subculture (on gelatine surface, in litmus milk, in gelatine shake, and in broth culture), as also to agglutination test with typhoid blood serum, proved to be colonies of the typhoid bacillus. Some few other colonies present on the phenol agar plate were, on subjecting them to appropriate tests, found to belong to the coli group of bacteria.

(*b*) The next trial was made at the end of 48 hours. in the same way as before. The result was that typhoid colonies were again recovered from the plate.

(*c*) After three days, a loopful of the mixture was similarly treated; but with the result that very few colonies of the typhoid bacillus appeared in the phenol agar plate. There were, however, a large number of colonies of coli-like microbes.

(*d*) After four days a loopful yielded no typhoid colonies; many of the colonies examined were bacillus coli or allied forms.

(*e*) After five days a further trial was made, with a like negative result.

Table 1 gives a summary of the results of experiment 1.

TABLE 1.

Test of the vitality of the typhoid bacillus in flour water; subculture of a platinum loopful of the mixture being made in each instance.

Test subsequent to inoculation of the flour.	Result as regards presence of the typhoid bacillus.
Immediately after inoculation	+ (large number of typhoid bacillus colonies).
(*a.*) After 1 day	+ (colonies fairly abundant).
(*b.*) After 2 days	+ (colonies not so abundant).
(*c.*) After 3 days	+ (very few colonies).
(*d.*) After 4 days	— (no typhoid colonies).
(*e.*) After 5 days	— (no typhoid colonies).

Hence, after three days there was a marked diminution of the typhoid bacilli in the flour water, and after four days a loopful of the mixture failed to yield any typhoid colonies at all.

Experiment 2.

In experiment 2 the procedure was the same as in experiment 1, except that when the diminution of typhoid bacilli recoverable from the flour water mixture became marked, larger amounts of the mixture were used for inoculation of the culture media.

One gramme of flour having been added to 9 cc. of sterile water, and the mixture inoculated from a recent growth of the typhoid bacillus, the whole was well shaken.

On culturing a loopful of the mixture after four days', and failing to recover any colonies of the typhoid bacillus, $\frac{1}{4}$ cc. of the mixture was next day added to phenol broth, which was incubated at 37° C. for 24 hours. From this phenol broth tube,

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which by this time had become slightly turbid, one phenol agar plate was made, and incubated at 37° C. On it, after 24 hours, numerous colonies were visible, which microscopically and in manner of growth resembled the typhoid fever micro-organism. From several of these colonies subcultures were made on gelatine surface, in shake gelatine, in litmus milk, and in broth. From the subculture on the gelatine surface after 24 hours, an emulsion was made and tested with typhoid blood serum (50 : 1), with the result that the bacilli of the emulsion were completely agglutinated in 15–20 minutes. Further, all the subculture tests proved that the microbes in question were typhoid fever bacilli.

Nine days after infection, ½ cc. of the same flour water typhoid mixture was added to phenol broth. The result was negative; no typhoid colonies were recovered, only colonies seemingly, of bacillus coli were present in the phenol agar plate made therefrom.

The results of experiment 2 are shown in Table 2.

TABLE 2.

Test of the vitality of the typhoid bacillus in flour water, using large amounts of the mixture for subculture.

Test subsequent to inoculation of the mixture.	Result as regards presence of the typhoid bacillus.
A loopful after 4 days	— (no typhoid colonies).
½ cc. after 5 days	+ (numerous typhoid colonies).
½ cc. after 9 days	— (no typhoid colonies).

It appears, then, from experiment 2 that though after four days a loopful of the mixture yielded no typhoid colonies, a considerably larger quantity of the mixture (½ cc.) still contained the living typhoid bacilli; but that after nine days this bacillus was not recoverable from the flour water, notwithstanding that so much as ½ cc. of the mixture was tested for its presence.

B.—*Bacillus Diphtheriæ and Wheat Flour.*

Experiment 3.

(*a*) From a well shaken mixture of flour water inoculated 24 hours previously with bacillus diphtheriæ, an agar surface plate was made, one platinum loopful being used for this purpose.

After incubation of the plate for 24 hours there appeared upon it, amongst a number of others, some colonies that looked like those of diphtheria. These, by subculture and by animal experiment, were proved to be colonies of the diphtheria bacillus.

(*b*) A like experiment was made with one loopful of the flour water two days after addition to it of diphtheria culture. The result was negative; no diphtheria colonies could be recovered.

(*c*) The experiment was repeated after lapse of further two days, using this time ¼ cc. of the mixture. The result was negative; many of the colonies in the agar plate were those of bacillus mesentericus. Table 3 shows a summary of the results with bacillus diphtheriæ.

TABLE 3.

Test subsequent to inoculation of the flour water.	Result as regards presence of the diphtheria bacillus.
Immediately after inoculation, with 1 loop.	+ (large number of diphtheria colonies).
(*a*.) 1 loopful after 1 day	+ (some diphtheria colonies).
(*b*.) 1 loopful after 2 days	— (no diphtheria colonies).
(*c*.) ¼ cc. after 4 days	— (no diphtheria colonies).

From these experiments it would seem that the bacillus diphtheriæ in the flour water exhibited less sustained vitality than the typhoid bacillus. A loopful of the mixture, which at starting contained large numbers of the diphtheria bacillus, failed to yield after two days any colonies of this micro-organism; and, further, after four days a negative result was obtained even with ¼ cc. of the mixture.

C.—*Staphylococcus Pyogenes Aureus and Wheat Flour.*

Experiment 4.

One gramme of flour (unsterilised) was added to 9 cc. of sterile water contained in a test tube. The tube after being well shaken was inoculated with a small platinum loopful of the surface growth on agar of staphylococcus pyogenes aureus. It was then plugged with sterile cotton wool, and kept in a dark cupboard at

the room temperature.* From time to time a platinum loopful of the mixture was, after preliminary shaking, removed from the tube and spread over the surface of a number of oblique agar tubes. These were then incubated at 37° C. The presence of S. pyogenes aureus, when it appeared in these agar tubes, was readily recognised by its characteristic coloured growth and by further study in subculture. The results obtained are shown in Table 4.

TABLE 4.

Test of the vitality of staphylococcus pyogenes aureus in unsterilised flour (1 gramme) mixed with sterilised water (9 cc.), when added thereto in large amount.

Test, in each instance with one loopful of the mixture, subsequent to inoculation of the flour and water with S. pyogenes aureus.	Results as regards the presence of S. pyogenes aureus.
Immediately after the inoculation ...	+ (present, practically in pure culture).
3 days after the inoculation	+ (present in great number).
6 days do. do.	+ (evidence of reduction in number).
7 days do. do.	+ (comparatively few colonies noted).
9 days do. do.	+ (only a few colonies noted),
11 days do. do.	+ (very few colonies noted).
13 days do. do.	+ (only one colony noted)
15 days do. do.	— (no colonies).
17 days do. do.	— (no colonies).

Thus, staphylococcus pyogenes aureus retained its vitality in the mixture of flour and water for 13 days. Though originally present in great abundance in the flour water, there was by the sixth and seventh days a striking reduction in the number of staphylococcus pyogenes aureus.

* Previous to the introduction of S. pyogenes aureus agar cultures were made from the mixture of flour and water. But no colonies liable to be mistaken for S. aureus were noted.

Experiment 5.

The above experiment with staphylococcus pyogenes aureus in flour water was repeated, but instead of using for cultivation one loopful of the mixture a larger amount was added in each instance to the subculture medium.

(*a*) To a mixture of 1 gramme of the flour in 9 cc. of sterile water there was added a loopful of recent growth on the surface of agar of staphylococcus pyogenes aureus. Sixteen days later, ½ cc. of the mixture was added to ordinary nutrient broth, which, having been incubated at 37° C. for 24 hours, became very turbid. From this turbid broth a surface agar plate was made in the ordinary way. No staphylococcus colonies could be found; but numerous colonies of bacillus coli were noted.

(*b*) Eighteen days after inoculation of the flour water with the staphylococcus, ½ cc. of the mixture was added to broth in a tube, and this was incubated for 24 hours at 37° C. From the broth, which by this time had become turbid, one agar surface plate was inoculated. After incubation for 24 hours this plate showed colonies of staphylococcus aureus in fair numbers.

(*c*.) Twenty-four days after inoculation, 1 cc. of the mixture was added to broth. After 24 hours incubation of the broth a surface agar plate was inoculated therefrom, and incubated at 37° C. for 24 hours. This plate showed numerous colonies of staphylococcus aureus.

(*d*.) After 30 days 1 cc. of the same mixture was added to broth. The result was that no staphylococcus colonies could be recovered in agar plate culture of the broth samples.

The results of this series are summarised in Table 5.

TABLE 5.

Test subsequent to inoculation of flour-water with staphylococcus aureus; using for culture large amounts of the mixture.	Results as regards presence of staphylococcus aureus.
(*a*.) After 16 days; with ½ cc. of the mixture.	— (no colonies of the micro-organism).
(*b*.) Do. 18 do. do. ½ cc. do.	+ (growth do. do.).
(*c*.) Do. 24 do. do. 1 cc. do	+ (growth do. do.).
(*d*.) Do. 30 do. do. 1 cc. do.	— (no colonies do. do.).

From this experiment it appears, as indeed was shown in that preceding it (Table 4), that the number of staphylococci in the flour-water is strikingly reduced by the end of the second week, though by using larger amounts (1 cc.) of the mixture for cultivation, living staphylococcus can be demonstrated up to 24 days.

D.—*Vibrio of Cholera and Wheat Flour.*

Experiment 6.

This experiment was carried out on the lines already indicated, except that the peptone method was adopted in place of agar cultures to ascertain the presence of the cholera vibrio in the flour-water.*

TABLE 6.

Test of the vitality of the cholera vibrio in unsterilised flour (1 gramme) mixed with sterile water (9 cc.) when added thereto in large amount:—

Test subsequent to inoculation of the flour-water; using for culture, unless otherwise stated, one loopful.	Results as regards presence of the cholera vibrio.
Immediately after the inoculation ...	+ (the vibrio was present practically in pure culture, and cholera red reaction positive).
3 days do. do. ...	? + (if positive, slight morphological change of the vibrio; cholera red reaction doubtfully positive).
6 days do. do. ...	− (no cholera red reaction.)
7 days do. do. ... (1 cc. used for inoculation.)	− (here, though 1 cc. instead of a platinum loopful of the mixture was added to the peptone, no cholera red reaction was obtained and no vibrios were found on microscopic examination.

It is here seen that the cholera vibrio, unlike staphylococcus pyogenes aureus, rapidly lost its vitality in the mixture of flour and water. In the peptone tubes inoculated from the mixture immediately after addition of the cholera vibrio, this micro-organism was found to be present in great abundance and practically in pure culture. Yet by the third day the result was only doubtfully positive, and peptone cultures inoculated after the sixth and seventh days yielded totally negative results.

* Peptone tubes were inoculated from the mixture of flour and water previous to the introduction into it of the cholera vibrio. These peptone tubes were incubated at 37° C. for 24 hours, and stained cover glass preparations made from the surface layers of the liquid. On microscopic examination no vibrios were detected. Tested for the "cholera-red" reaction a negative result was obtained.

Experiment 7.

This was a repetition of the previous experiment,

TABLE 7.

Test of the vitality of the cholera vibrio in unsterilised flour (1 gram.) mixed with sterile water (9 cc.), when added thereto in large amount :—

Test subsequent to inoculation of the mixture of flour and water; using for culture, unless otherwise stated, one loopful.	Results as regards the presence of the cholera vibrio.
2 days after the inoculation	+ (vibrios present in abundance, and cholera red reaction positive).
6 days do. do.	+ (do. do. do.).
9 days do. do.	— (negative: cholera red reaction also negative).
10 days do. do. ... ... (1 cc. used for inoculation.)	— (here, though 1 cc. instead of a platinum loopful was added to the peptone, no cholera red reaction was obtained and no vibrios were found on microscopic examination.
11 days do. do. ... ... (1 cc. used for inoculation.)	— (do. do. do.).

In this experiment the cholera vibrio was alive the sixth day after the inoculation of the mixture of flour and water. But a negative result was obtained on the ninth, tenth, and eleventh days.

Although in this experiment the cholera vibrio had survived a little longer than in Experiment 6, there was no indication (the reverse rather) that the mixture of flour and water was favourable to its vitality.

E.—*Bacillus pyocyaneus, and wheat flour.*

Experiment 8.

Bacillus pyocyaneus was added, as in the preceding experiments, to a mixture of flour and water.

TABLE 8.

Test of the vitality of bacillus pyocyaneus in unsterilised flour (1 gramme) mixed with sterile water (9 cc.), when added thereto in large amount :—

Test subsequent to inoculation of the flour and water; using for culture, one loopful.	Results as regards the presence of bacillus pyocyaneus.
6 days after the inoculation	+ (B. pyocyaneus present in abundance).
11 days do do.	+ (do. do. do.).
14 days do. do.	+ (do. do. do.).
18 days do. do.	— (B. pyocyaneus absent.)
21 days do. do.	— (do. do.)

It will be noted that bacillus pyocyaneus survived to the fourteenth day after inoculation of the medium. Later it could not be found in this mixture of flour and water.

SERIES II.—EXPERIMENTS WITH OATMEAL.

The same procedure was adopted with oatmeal as with flour. One gramme of fine oatmeal flour, bought at a retail shop, was added to 9 cc. of sterile water, and the mixture was inoculated with a loopful of the growth from the slanting surface of a recent agar culture of the microbe of experiment. The whole was then well shaken and kept in a dark cupboard at the temperature of the laboratory.

A.—*Bacillus of typhoid fever and oatmeal.*

Experiment 9.

(*a.*) Immediately after inoculating the oatmeal and water, a loopful of the mixture yielded in the phenol agar surface plate innumerable typhoid bacillus colonies. Forty-eight hours later a loopful of the mixture on a phenol agar surface plate yielded also numerous colonies looking like those of the typhoid bacillus. Sub-cultures made from several of these colonies responded to all the tests of the typhoid bacillus—agglutination with typhoid fever blood was almost instantaneous.

(*b.*) The next trial was made five days after the infection of the oatmeal and water, also with a loopful. The result was

totally negative; numerous colonies of cocci only were present. So that in the interval between two and five days an enormous reduction had taken place in the number of living typhoid bacilli in the mixture. On account of this great reduction in the number of typhoid bacilli in the oatmeal mixture two further tests were made.

(c.) Six days after infection of the oatmeal mixture, $\frac{1}{4}$ cc. of it was added to phenol-broth which was incubated at 37° C. From this broth culture a phenol agar surface plate was next day made which yielded numerous typhoid colonies.

(d.) Ten days after inoculation of the oatmeal the experiment was repeated, this time with $\frac{1}{2}$ cc. of the mixture. The result was negative. Table 9 gives a summary of these results.

TABLE 9.

Test subsequent to the inoculation of oatmeal water with typhoid bacilli.	Result, as regards presence of the typhoid bacillus.
(a.) Immediately after inoculation (with one loop).	+ (large number of typhoid colonies).
(a.) 2 days after inoculation (with one loop).	+ (numerous typhoid colonies).
(b.) 5 days do. do. do.	— (no typhoid colonies).
(c.) 6 days do. do. $\frac{1}{4}$ cc. ...	+ !
(d.) 10 days do. do. $\frac{1}{2}$ cc. ...	—

In respect of inimical action, oatmeal water behaved toward the typhoid bacillus in practically the same way as the wheat flour water.

B.—*Bacillus diphtheriæ and oatmeal.*

Experiment 10.

This bacillus proved the reverse of hardy in oatmeal water, less hardy even than in wheat flour water. Using a loopful of the mixture immediately after inoculation, large numbers of diphtheria colonies were recognised; and one day after inoculation there were still some diphtheria colonies recovered. But after two days none were obtained. And, as in the case of wheat flour, after four days not even $\frac{1}{4}$ cc. of the mixture yielded diphtheria colonies. The mixture, however, yielded an abundance of colonies of the bacillus citreus cerealis described by

us in last year's report, and possibly the rapid proliferation of this microbe helped to suppression of the diphtheria bacilli.

TABLE 10.

Test subsequent to inoculation of the oatmeal water with diphtheria bacilli.	Result, as regards presence of the diphtheria bacillus.
Immediately after infection (with one loop).	+ (large number of diphtheria colonies).
1 day do. do. do.	+ (diphtheria colonies).
2 days do. do. do.	– (no diphtheria colonies).
4 days do. do. (with ½ cc.)	– (no diphtheria colonies).

C.—*Vibrio of cholera and oatmeal.*

Experiment 11.

The experiment was carried out in the same way as in Experiments 6 and 7, Series I., except that fine oatmeal was used in the place of flour.

TABLE 11.

Test of the vitality of the cholera vibrio in unsterilised fine oatmeal (1 grm.) mixed with sterile water (9 cc.), when added thereto in great amount :—

Test subsequent to inoculation of the mixture of fine oatmeal and water with the cholera vibrio; using for culture, one loopful.	Results as regards the presence of the cholera vibrio.
2 days after the inoculation	+ (vibrios present almost in pure culture; cholera red reaction positive).
4 days do. do. ...	— (no vibrios; no cholera red reaction).
7 days do. do. ...	— do. do. do.

It will be seen that the cholera vibrio was alive on the second day after the inoculation, but that a negative result was obtained on the fourth and seventh days.

D.—*Bacillus pyocyaneus, and oatmeal.*

Experiment 12.

This experiment was carried out in the same way as in Experiment 8, Series I., except that fine oatmeal was used instead of flour.

TABLE 12.

Test of the vitality of bacillus pyocyaneus in unsterilised fine oatmeal (1 grm.) mixed with sterile water (9 cc.), when added thereto in large amount :—

Test subsequent to inoculation of the mixture of fine oatmeal and water with bacillus pyocyaneus; using for culture, one loopful.	Results as regards the presence of bacillus pyocyaneus.
2 days after the inoculation	+ (bacillus present almost in pure culture).*
4 days do. do. ...	+ (abundant growth of bacillus pyocyaneus).
7 days do. do. ...	— (B. pyocyaneus absent)
9 days do. do. ...	— (do. do. do.)

* A broth culture was made from one of the colonies, and incubated at 37° C. for 24 hours. ½ cc. of this broth culture killed a guinea-pig within 24 hours.

Bacillus pyocyaneus was alive on the fourth day after inoculation, but on the seventh and ninth days the result was wholly negative.

SERIES III.—EXPERIMENTS WITH GROUND RICE.

In this series the experiments were conducted in precisely the same way as before. One gramme of ground rice, bought in a retail shop, was added to 9 cc. of sterile water, and the mixture having been inoculated with a loopful of growth of the microbe of experiment (taken from the slanting surface of a recent agar culture), was well shaken and put by.

A. *Bacillus of typhoid fever and ground rice.*

Experiment 13.

The experiments conducted with this microbe had to be rather numerous on account of its greater vitality in the rice and water mixture. That it, as also (as will presently be seen) certain of the other microbes of experiment, preserved their vitality

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longer in the rice and water than in flour or in oatmeal can, we think, be readily explained by a fact noticed in the course of the investigation: Namely, that conspicuously fewer extraneous microbes were contained in rice than in flour or in oatmeal. Not until many days had passed was there any great number of these extraneous microbes noticed in the rice-water plates, whereas in the case of the flour-water and of the oatmeal-water plates coli-like microbes, bacillus mesentericus, and bacillus citreus cerealis abounded early in the course of the experiments. The multiplication of these micro-organisms must needs have had an injurious effect on such highly specialised and little resisting pathogenic microbes as *some* that were used in our experiments.

The results of experiment 13, made with the typhoid bacillus, are summarised in the following Table:—

TABLE 13.

Test of the vitality of the typhoid bacillus in ground rice and water.

Test subsequent to inoculation of the rice water with the typhoid bacillus.	Result as to presence of the typhoid bacillus.
Immediately after infection (with one loop).	+ (Pure culture of typhoid bacillus; innumerable colonies).
2 days after infection (with one loop)	+ (Pure culture; typhoid bacillus colonies abundant).
5 days do. do. ...	+ (Very numerous typhoid bacillus colonies).
8 days do. do. ...	+ (Very numerous typhoid bacillus colonies).
11 days do. do. ...	+ (Only twelve colonies of typhoid bacillus).
14 days do. (with two loops)	+ (One colony only of typhoid bacillus).
18 days do. (with ½ cc.) ...	+ (Phenol broth turbid, yielded on agar plate typhoid bacillus colonies).
21 days do. (with 1 cc.) ...	+ (Phenol broth yielded typhoid bacillus colonies).
25 days do. do. ...	+ (Phenol broth yielded typhoid bacillus colonies).
29 days do. do. ...	— (No typhoid colonies; numerous colonies of bacillus mesentericus).

It is seen from the above table that a distinct reduction in the number of living typhoid bacilli was observed on the twelfth day; and that on the fifteenth day the reduction was

striking, since two loopsful of the mixture only yielded a single colony of the typhoid bacillus. By the thirtieth day even a whole cubic centimetre yielded none at all. The before-mentioned comparative absence for some time from these experiments of extraneous microbes was marked. In the experiment with two loopfuls spread out on the surface of an agar plate, extraneous microbes were relatively absent; and only after the rice and water mixture had been kept for nearly one month could the presence of saprophytic microbes, notably, bacillus mesentericus, be demonstrated.

B.—*Bacillus Diphtheriæ in Ground Rice.*

Experiment 14.

Here also *relatively* long survival of the microbe in the rice and water was noticed, as is shown by the results of the experiments summarised in Table 14.

TABLE 14.

Test subsequent to inoculation of the rice water with bacillus diphtheriæ.	Results as regards presence of the diphtheria bacillus.
Immediately after infection (with one loop).	+ (Innumerable colonies of diphtheria bacillus).
2 days after infection (with one loop)	+ (Numerous colonies of bacillus diphtheriæ, also some of bacillus citreus).
3 days do. (with one loop)	+ (Some colonies of bacillus diphtheriæ, virulent on injection into guinea pig).
5 days do. (with two loops)	— (No diphtheria colonies; abundance of bacillus citreus, also cocci).
7 days do. (with 1 cc.) ...	— (Broth turbid, but yielded only cocci).

From these experiments it appears that, though the bacillus diphtheriæ survived a little longer in the rice and water than in flour or oatmeal and water respectively, it proved, as might be expected, considerably weaker and less resisting than the typhoid bacillus.

C.—*Vibrio of Cholera and Ground Rice.*

Experiment 15.

The results of experiment 15 are shewn in Table 15.

TABLE 15.

Test of the vitality of the cholera vibrio in unsterilised ground rice (1 gramme) mixed with sterile water (9 cc.), when added thereto in large amount :—

Test subsequent to inoculation of the mixture of ground rice and water with the cholera vibrio ; using for culture, one loopful.	Results as regards the presence of the cholera vibrio.
2 days' after the inoculation	+ (vibrio present in great abundance ; cholera red reaction positive).
5 days do. do.	— (vibrio not found ; cholera red reaction also negative).
9 days do. do.	— (vibrio not found ; cholera red reaction also negative).

Although a positive result was obtained on the second day after inoculation, no vibrios could be found in the peptone cultures made on the fifth and ninth days.

D.—*Bacillus Pyocyaneus and Ground Rice.*

Experiment 16.

The results of experiment 16 are shown in Table 16.

TABLE 16.

Test of the vitality of bacillus pyocyaneus in unsterilised ground rice (1 gramme) mixed with sterile water (9 cc.), when added thereto in large amount :—

Test subsequent to inoculation of the mixture with bacillus pyocyaneus ; using for culture, one loopful.	Results as regards the presence of bacillus pyocyaneus.
2 days after the inoculation	+ (the bacillus present in almost pure culture).
5 days do. do.	+ (present in abundance).
9 days do. do.	+ do. do. *
12 days do. do.	+ (not so numerous).
15 days do. do.	+ do. do.
29 days do. do.	+ (present, but in sparse proportion).§
36 days do, do.	— (B. pyocyaneus absent.)
39 days do. do.	— (do. do. do.)

* A broth culture was made from a single colony of bacillus pyocyaneus and incubated at 37° C. for 24 hours. Of this broth culture 0·5 cc. killed a guinea-pig in 4 days.

§ A broth culture was made from a single colony of bacillus pyocyaneus and incubated at 37° C. for 24 hours Of this broth culture 1 cc. killed a guinea-pig in 2 days.

Bacillus pyocyaneus, therefore, was alive and virulent in the mixture of ground rice and water as late as the 30th day after inoculation. Later it could not be isolated.

SUMMARY.

The foregoing experiments seem to indicate that of the different farinaceous media employed, wheat flour and oatmeal afford on the whole less opportunity of survival to the pathogenic micro-organisms that are in question than does rice flour. Of the pathogenic microbes submitted to these media, bacillus diphtheriæ and the cholera vibrio appear to be less capable of persisting in all three media than the typhoid bacillus staphylococcus pyogenes aureus, and bacillus pyocyaneus.

Considering that a vast number of micro-organisms were added in each experiment to a relatively small quantity of farinaceous medium, the likelihood of infection of the human subject by means of these cereals may perhaps reasonably be thought of as somewhat remote. The relatively low vitality of the typhoid bacillus when associated with some of these cereals is, in view of its seemingly higher resistence to the influence of at all events some samples of sewage and of water, worth noting.

In conclusion, however, it needs to be recalled that these experiments were so far arbitrary that the sterilised water added to the farinaceous food was in the somewhat large proportion of 9 cc. to 1 gramme. This had been found by preliminary experiment to be practically the only way of obtaining a "workable" mixture of the food and the water. Possibly identical results might not have been observed had the ratio of water to food been less.

No. 2.

App. B, No. 2

On Bacterioscopic Analysis of Food Stuffs; by Dr. Klein, F.R.S.

REPORT on the BACTERIOSCOPIC ANALYSIS of VARIOUS FOOD STUFFS; by DR. E. KLEIN, F.R.S.

During the last ten years the results of a number of analyses have been published showing the bacteriological purity or impurity of a variety of articles of food. Amongst these analyses are those published in the course of several years by the Kaiserl-Gesundheitsamt, in Berlin; others published more recently by the Thompson-Yates Laboratory, in Liverpool; and others again by the Massachusetts Board of Health.

Except as regards tubercle bacilli or allied micro-organisms in milk, cream, butter, and cheese, specific microbes have not been often sought for in food stuffs; observations have, as a general rule, been directed to determining the sterility or otherwise of the examined articles.

In the research here to be recorded the examinations were undertaken less with the object of determining whether particular food articles were free of microbes, or contained few or many of them, than of ascertaining whether these articles harboured microbes which could exert any pathogenic action on animals. It must be obvious, indeed, that a food stuff—as for instance milk, cream, butter, cheese, as ordinarily sold—however numerous the microbes contained in it, may be nevertheless perfectly harmless to the persons consuming it. Articles of food of the above sort do, it is perfectly well known, contain vast numbers of bacteria that must be harmless, since enormous quantities of these articles are consumed without producing any ill effects. No information whatever, therefore, as to the sanitary excellence, or the reverse, of such food is conveyed in the statement that a sample has been found to contain so many, per c.c. or per gramme, thousands or hundred-thousands of microbes. It is notorious that milk as ordinarily consumed and found in all respects wholesome, contains microbes not merely by the thousands, but as a rule by the hundred thousand, occasionally even by the million, in each cubic centimetre. The same is true, in perhaps a higher degree, of cheese, of butter, and of cream. Unless, therefore, bacterioscopic analysis does more than ascertain the numbers of bacteria in food, *i.e.*, unless it proceeds to the discovery of the several sorts of specific microbe contained in a food, it does not throw much light on the hygienic value of the given food article.

The food substances which I have subjected to bacterioscopic analysis, in order to detect whether or not they contain specific microbes were:—

(I.) Milk and allied substances; such as butter, margarine.

(II.) Tinned substances; like condensed milk, ham, and salmon.

(III.) Other preserved food; as for instance sausages.

The microbes searched for in the first series of food stuffs were :—

(1.) Bacillus tuberculosis.

(2.) Bacillus pseudotuberculosis.

(3.) Acid-fast bacilli possessed of pathogenic character, such as observed by Petri, Rabinovitsch, Moeller, and others.

In the course of my inquiry several pathogenic microbes not hitherto described were met with, which in due course will receive proper notice and description.

Series I.—Milk and Allied Substances.

Milk.

Tubercle bacillus.

The occurrence of bacillus tuberculosis in milk derived from the tuberculous udder of the cow is fully established by numerous observers, as is also the occasional, though not so frequent, presence of it in milk derived from tuberculous cows having their udders seemingly free of the disease. As regards the latter, however, the recorded observations differ widely. For instance, Bang, in Copenhagen (Deutsche Zeitschrift f. Thiermedizin, &c., 1884 and 1891), found that the milk of 63 cows with advanced tuberculosis proved tuberculous in only 14 per cent. Hirschberger (Archiv f. Klin. Med., 1889) on the other hand found the milk tuberculous in over 50 per cent. of diseased cows, even when the tuberculous process in the lung of the cow was only very limited in extent. And like differences were found by many other observers. Ostertag (Zeitschrift fur Fleisch and Milchhygiene, 1899), experimenting with the milk of 50 cows giving positive reaction with tuberculin but exhibiting clinically no sign of disease, failed to demonstrate the infective power of any of the milk. On the other hand Rabinovitsch and Kempner (Zeitschrift fur Hygiene, 1889, vol. 1), testing the milk of a series of cows, all of which during life gave positive reaction with tuberculin, and which later were subjected to a careful post-mortem examination, found in regard of nine cows, free of udder disease but which presented clinically or pathologically (or in both ways) evidence of lung tuberculosis, that their milk proved tuberculous in five cases, *i.e.* in over 50 per cent.

Not less widely different are the results obtained by various observers with regard to "mixed milk," *i.e.* milk such as is, in large cities, sold retail, and which has been derived from a number of different sources. From Dr. Annett's paper in the Report of the Thompson-Yates Laboratories, vol. ii., p. 29 (Tubercle Bacilli in Milk, Butter, and Margarine), it appears that, according to Obermüller, Berlin samples of milk in 1895, proved in 61 per cent. of the examinations tuberculous; whereas Petri, in 1898, found only 14 per cent. of Berlin milk to be so infected. Rabinovitsch and Kempner, in 1899, found that of 25 samples of Berlin milk 28 per cent. were tuberculous. As regards Liverpool, according to a report (1897) of the Medical Officer of Health, of milk samples derived from sources within that city,

2·8 per cent. yielded tubercle bacilli, whereas of samples of milk brought into Liverpool from outside (Cheshire, Shropshire, &c.), less than 29·1 per cent. were found to be tuberculous. In 1898, Boyce, in Liverpool, found 8·3 per cent. of the "town" milk, and 17·8 per cent. of country milk, tuberculous. Kanthack and Sladen found that of samples of milk from 16 Cambridgeshire dairies 56·3 per cent. were tuberculous.

I may here at once point out one source of difference in these widely divergent figures. The number of samples examined by the different experimenters differed very widely, so widely indeed as to render comparisons, such as seem to be suggested, altogether unjustifiable. For instance, Rabinovitsch and Kempner base their estimate of 28 per cent. on the examination of 25 samples; Kanthack and Sladen on that of 16 samples; Liverpool "country" milk is based, in 1897, on 24 samples, and "town" milk on 144 samples; in 1898, town milk on 84 samples, and country milk on 28 samples. Wherefore it is quite clear that if in this matter any correct and reliable insight is to be gained, it is necessary that samples of milk should be repeatedly examined over a considerable period of time, and that the milk tested should be, as far as possible, always of the same general character and from the same sources.

Take, for instance, one of the large milk-supply companies which derives its milk supply from a number of known farms, and suppose, as is generally the case, that these farms are, as far as this milk company is concerned, constant contributors. In such case it would be well to have daily samples of milk taken and examined as received from each of these farms. After 100 samples of each such milk had thus been tested a just estimate could be made as to the percentage of the milk infective. Similarly, when all the milk supplied to a retailer by a given company is previous to delivery mixed, a sample may be taken twice daily and examined; after one, two, or three hundred samples had been thus examined a just estimate could be obtained of the percentage of infective milk delivered to the retailer by that company. How misleading may be statements as to such and such percentage of infected milk, based on examination of a small number of samples, I illustrate by quoting the following actual occurrence:—

Last year, in the course of a few months, I examined for tubercle 98 samples of milk derived from known farms and delivered at particular London stations. The milk was taken in each instance by the Sanitary Inspector direct from the churn, received into a specially sterilised bottle, and brought direct to the laboratory and examined. The first 38 samples yielded a percentage of nearly 15 per cent, of tuberculous milk. Then came a long series of samples (over 40) which were free from any tubercle. Then again came a short series of samples of which the percentage was even higher than in the first instance. Then came a short series of samples which was free from tubercle. Now, had examination ceased with the first 38 samples, it might have been considered that the "country" milk delivered into London is to the extent of 15 per cent. tuberculous; and had examination been limited to the next 40 samples, "country" milk

might have been regarded as free from tubercle. Further, had only the short series (about 12) of samples that followed the above 80 samples been dealt with, the amount of tuberculous "country" milk would have been found to be more than 20 per cent. As a matter of fact, after examining 98 samples of country milk I had to state that only 7 per cent. of the whole were tuberculous; and, further, I was able to affirm for this series of examinations that, at the particular time, a number of farms, and even a series of counties, were not sending tuberculous milk.

In commenting on the results of examining milk samples for tubercle, it is necessary to remember that examination by the microscope *alone* for tubercle bacilli in milk consigned in bulk to market, is practically of no use. Unless the sample contains a fair number of bacilli, such as are, for instance, occasionally met with in a sample of milk drawn directly from a tuberculous udder, the chances are not very great of finding them in cover film specimens. I am assuming, of course, that such films are not merely prepared with a droplet of the original milk, but that they are made from the sediment (after allowing the milk to stand in a cool place for some 20–24 hours, or after centrifuging) of a considerable quantity, say 200–250 cc. of the milk. The milk, however, which is generally submitted to analysis is not milk derived from a single, possibly tuberculous, cow, but is mixed milk, *i.e.*, such as has been derived from several, often many, cows. Assuming, therefore, that there was amongst the herd one cow affected with tuberculous deposits of the udder, the tubercle bacilli derived from such single cow may have become widely distributed, diluted as it were, by admixture with a great bulk of normal milk. Like others, I of course have been able to demonstrate in the sediment of particular milk samples tubercle bacilli by film specimens; but in such case the milk (about half a pint) had been taken direct from the udder of a cow which the Veterinary Inspector had declared tuberculous. Amongst seven tuberculous samples (out of the 98 total London samples) I have been able to find typical tubercle bacilli in cover film specimens prepared from the sediment of 250 cc., in not more than a single case; in the remaining six instances cover film specimens failed to demonstrate them.

Experiment on the guinea-pig is, after all, the only sure test. Injection, subcutaneous or intraperitoneal (I have always employed both methods), of the sediment of the milk infallibly produces in due time tuberculous deposits in these experimental animals if tubercle bacilli are present in that deposit of the milk.

Acid-fast bacilli.

While the absence of tubercle bacilli in film specimens of milk might mislead in a negative direction, their seeming presence might, on the other hand, mislead in a positive direction; for the reason that there exist in milk bacilli which as regards staining power—acid-fastness—simulate the true tubercle bacilli. Petri (Arbeiten aus dem K. Gesundheitsamte, 1898), Meoller (Therapeutische Monatsheft, 1898). have met with bacilli in milk which resembled the true tubercle bacilli in that they were cylindrical and were possessed of the acid-fast character, though they differed from them in being thicker and shorter—more or less club shaped. This acid-fast character is one which is of great importance, since

these acid-fast bacilli in milk and preparations of milk might be, and possibly have been, on microscopic examination alone, mistaken for true tubercle bacilli.

These acid-fast bacilli differ from the true tubercle bacilli not only as regards culture but also as regards pathogenic action. As regards culture, they grow rapidly on ordinary agar as a thick creamy layer; they grow well on ordinary potato; they also grow on gelatine at the temperature of the room. So that in these respects they are utterly unlike true tubercle bacilli. Acid-fast non-tuberculous bacilli produce, on intraperitoneal injection of the guinea-pig, in most instances and in the course of three or four weeks, disseminated purulent or caseous nodules in the peritoneum and omentum; on the surface of the liver, in the spleen, and on the surface of the lungs. Film specimens of the nodular matter in question shows the above acid-fast bacilli in abundance. Rabbits are not susceptible to infection in this way. Petri, Moeller, as also and particularly Rabinovitsch (as well as others), who met with them also in butter, speak of these acid-fast non-tubercular bacilli as bacillus pseudotuberculosis, and term the disease produced by them in the guinea-pig pseudotuberculosis. I shall have presently to point out the confusion to which such terminology may and actually has given rise. At present I am merely concerned with pointing out the inadequacy of making diagnosis of tubercle in milk from microscopic examination alone—of identifying true tubercle in it by the presence merely of acid-fast cylindrical bacilli.

Bacillus pseudotuberculosis.

Amongst the 98 samples of country milk already referred to I did not meet once with the acid-fast pseudotubercle bacilli of Petri and Rabinovitsch. I have, however, met eight times with the non-acid-fast bacillus pseudotuberculosis of A. Pfeiffer. In last year's report I fully described and illustrated the morphological and cultural characters of this microbe; also its specific and its acute action on guinea-pigs, rabbits, and mice. I in particular drew attention, in confirmation of Pfeiffer's results, to the action of the bacillus administered to guinea-pigs with their food; to its ability to cause, when thus administered, within a few weeks lesions which in their distribution and naked eye aspects are a remarkable imitation of true tuberculosis in the guinea-pig. I have also pointed out the occurrence of this microbe in sewage and in sewage polluted water. Comparing the description of this bacillus given by me in last year's report with that of the acid-fast bacillus pseudotuberculosis of Petri and Rabinovitsch, it will be seen that the bacillus pseudotuberculosis of A. Pfeiffer differs not only with regard to morphology and culture from the bacillus pseudotuberculosis of Petri and Rabinovitsch, but still more as regards its pathogenicity on rodents. The bacillus pseudotuberculosis of A. Pfeiffer, which is not an acid-fast bacillus, has on account of its resemblance in anatomical effect to that of the true tubercle bacillus been rightly called bacillus pseudotuberculosis, and as such it has been accepted since 1887 (the year of its isolation by Pfeiffer) by bacteriologists in general and by text books in particular. It is therefore inconvenient to term another and altogether different microbe "pseudotuberculosis bacillus," since this must of necessity lead to confusion. There is the greater need to insist on this as in

several recent publications (Annett, Public Health Journal and some American authors) the term bacillus pseudotuberculosis is used to denote the acid-fast bacillus of Petri and Rabinovitsch, and not the hitherto recognised bacillus pseudotuberculosis.

[One point upon which it is necessary to lay stress with regard to the acid-fast condition of the bacillus of Petri and Rabinovitsch is the methods by which this acid-fast condition may be demonstrated. When materials containing the true tubercle bacillus of Koch are dried as a thin film on a cover glass, stained in boiling carbol-fuchsin of Ziehl and well washed for about 8 to 10 seconds in 33 per cent. nitric acid (Ehrlich), washed once more in water, and finally stained for a quarter of a minute in strong methylblue anilin water, the tubercle bacilli appear, as is well known, of a bright pink colour; and this despite the washing in 33 per cent. nitric acid with subsequent staining with methylblue. It is known that some other bacilli—the smegma bacilli and leprosy bacilli, for instance—possess this acid-fast property. Also it is well known that there are a host of various kinds of bacilli which when, after the fuchsin staining, they are subjected to the treatment with the 33 per cent. nitric acid take readily the (second) methylblue stain. There is, however, not any *a priori* reason why, supposing the treatment with the acid and the subsequent staining with the methylblue has not been fully carried out, some of such bacilli should not be capable of retaining some of the first fuchsin stain and thus reappear as if they were acid-fast. Experiment shows that if the nitric acid be of little strength (say 10 per cent. only), the washing in it shortened, and the staining in methylblue also shortened, various bacilli may seem as if they were acid-fast (*i.e.*, appear pink), although in reality when properly treated as I have described they would decolourise by acid and would readily take up the methylblue. This applies particularly to bacilli occurring in milk, in butter, and in other fatty materials, as was pointed out first by Marpmann. Everything depends, therefore, if a correct diagnosis of the acid-fast condition is to be made, on the nitric acid being 33 per cent. strength, on the washing in it being sufficiently sustained, and on the subsequent counter staining in methylblue being also sufficiently sustained. This latter process is of particular importance, for experiment shows (I have proved this again and again) that no really acid-fast bacilli take this blue counter stain, though the staining be carried out in methylblue anilin water for fully a quarter of a minute. Simple watery methylblue does not suffice, nor is shorter action than a quarter of a minute a true test. When therefore search is made for acid-fast bacilli in milk, butter, margarine, or other fatty materials, it does not suffice to use weak acid, *e.g.*, 10 to 20 per cent., to shorten the washing in it, or to counter stain in watery methylblue for a short time only; for under these conditions other bacilli, in reality not acid-fast, may and do retain more or less of the first fuchsin stain. Unless therefore, when acid-fast bacilli are professedly identified, the method is described by which these bacilli were demonstrated, no definite conclusion can be drawn; the simple statement, such as one constantly meets with, viz., that in this or that material acid-fast bacilli occur and that they are therefore either the true tubercle bacilli or the pseudotubercle bacilli of Petri, Rabinovitsch, and others, is not to be accepted without reservation.]

Other micro-organisms.

In testing the ninety-eight samples of "country" milk for the presence of tubercle bacilli, the sediment of 250 cc. of the milk sample was in each instance injected into two guinea-pigs; one half into the subcutaneous tissue of the one, the other half into the peritoneal cavity of the other guinea-pig. These animals were killed three to five weeks later. Over thirty per cent. of them showed abscesses at the seat of inoculation in the subcutaneously injected animals; in the omentum at one or other point of the mesentery, on the liver, or on the spleen in those intraperitoneally injected. As regards some milk samples, such abscesses were found either only in one animal (subcutaneous) or only the other (intraperitoneal); but in most instances both animals showed abscesses. The abscesses were in some cases small, not larger than a bean, in others the abscesses were as large as walnuts. The pus was of the consistency of thick cream, whitish yellow in colour, and contained no tubercle bacilli. But it was full of cocci. These were found to be in some instances almost pure cultivations of staphylococcus pyogenes aureus or luteus; in other instances the cocci were of the character of streptococcus pyogenes; in still other instances the microbe was streptococcus longus or brevis. In a few instances the pus contained an abundance of bacillus coli. It has of late years become almost the fashion to disregard and to, at any rate, discount the presence of the above microbes on account of their very wide distribution in nature. On the other hand, the infective, and particularly the pyogenic action of these microbes—inclusive of some races of bacillus coli—is well established by very many instances; instances too numerous to detail, as, for instance, cutaneous, subcutaneous, tonsillar, glandular, and visceral inflammations and abscesses. In the face of such facts, and in view also of the circumstance that we do not know under what conditions the pathogenic effect of one or the other of these microbes may be exercised, it seems rather arbitrary to disregard them altogether on the score of their being ubiquitous, and to pay no attention to their presence in substances of such general and frequent use as milk. Milk, containing streptococcus pyogenes or staphylococcus pyogenes, that can cause inflammation and abscess in the guinea-pig, may possibly produce a like pathogenic effect in previously abnormal or inflamed tonsils, and thus cause a purulent state of this organ—as, for instance, follicular tonsillitis, infectious (non-diphtheritic) sore throat, and the like. We have, it is true, no evidence, in cases of infectious non-diphtheritic sore throats, or of follicular tonsillitis associated with presence in the throat of staphylococcus aureus or of streptococcus pyogenes, that these microbes are really the primary cause of the diseased state. There is the fact only that these microbes are there in large numbers and that they are capable of causing pyogenic inflammation. But it is permissible to regard them with grave suspicion notwithstanding that they occur also in healthy throats. Thus we accept the diphtheria bacillus as the actual cause of diphtheria, notwithstanding that it is found also in throats that are not diphtheritic. For these reasons I think that the presence in considerable amount of staphylococcus pyogenes aureus and streptococcus pyogenes (disregarding for the moment bacillus coli) may not after all be so immaterial as some are inclined to make out; remembering

that milk in its unboiled condition is an almost daily article of food, and as such is brought into daily contact with the tonsils.

How these microbes found access to thirty odd per cent. of the milk samples (supposed to be pure country milk) it is impossible to say; whether they were extraneous admixtures, or were derived from a more or less inflamed skin of the teats or a quarter of the udder—a by no means infrequent condition of milch cows—is a subject which I had no means of ascertaining.

A pathogenic yeast.

Amongst the samples of country milk, there was one the sediment of which, although it caused no disease of any kind after intraperitoneal injection (the guinea-pig being killed three weeks after the injection), produced at the site of inoculation in the subcutaneously injected animal a tumour in the groin involving the inguinal lymph glands. This animal having been also killed three weeks after injection, showed on post-mortem examination all the viscera normal. But in the subcutaneous tissue there was a gelatinous soft grey tumour involving the hyperæmic swollen lymph glands; in fact these formed the central part of the tumour. The size of the tumour was about that of a filbert. Examined in the fresh state under the microscope, the tissue of the tumour was composed of leucocytes and masses of spherical torula-like cells, in small groups but mainly in continuous masses. These yeast cells were principally spherical in shape—one to three times the size of coloured blood discs. Amongst the larger examples some appeared pear-shaped or oval; also a fair number of longer and shorter cylindrical forms were seen which could be seen to have sprouted from the yeast cells. The presence of smaller and larger buds on the spherical cells showed that these are true blastomycetes. A detailed account of this micro-organism, which was observed to be possessed of pathogenic properties, will be found in addendum to this report.

Udder Affections in Relation with Milk.

Over 20 milch cows, affected with one or another kind of chronic inflammatory process in a quarter of the udder, were examined as to the characters of the secretion squeezed out from the affected quarter. In most instances this material was of the nature of pus and contained staphylococci, or streptococci, or both. The streptococci were found on cultivation to show either the cultural characters of streptococcus pyogenes or of streptococcus longus. In one instance, however, the secretion was a clear yellowish serum, in which was suspended a mass of blood-streaked fibrin. Under the microscope this contained, besides red and white blood corpuscles, streptococci. With the exudation—after dividing the fibrinous mass—a guinea-pig (No. 1) was injected on June 30th subcutaneously in the groin, and a second guinea-pig (No. 2) was injected intraperitoneally.

The intraperitoneally-injected animal was found dead within 48 hours, and on post-mortem examination presented the following appearances:—Great congestion of the peritoneum,

the peritoneal cavity containing, in large amount, a grey viscid purulent fluid, with many flocculi. In this fluid, when examined under the microscope, there were present leucocytes, and a few red blood discs; but the main portion of it was composed of smaller or larger masses of short streptococci, a few only of these occurring separately. These masses, in stained-film specimens, could be distinctly seen to be made up of convolutions of streptococci. The chains were generally curved and twisted and not of great length. These micro-organisms stain readily and well in Gram. Cultures were made on agar and gelatine with the exudation, after previous dilution with sterile salt solution. The cultures yielded pure growths of one and the same species of streptococcus.

The subcutaneously-injected guinea-pig (No. 1) showed, after 48 hours, a firm tumour in the subcutaneous tissue of the groin. After four days the tumour had considerably increased in size, but was still firm; and the animal remained in this condition till it was killed—July 12th. On post-mortem examination the inguinal glands at the seat of the injection were found much inflamed; their interior was purulent. Film specimens made of the pus showed abundance of masses of the same streptococci as were yielded by the exudation of guinea-pig No. 2.

A considerable number of experiments were made with the cultures derived from the peritoneal exudation of guinea-pig No. 1. Small doses (a few drops) of emulsion of the condensation fluid of such agar or broth cultures were injected subcutaneously into the groin of guinea-pigs. As a result, in all instances a subcutaneous tumour, followed by a purulent abscess, was formed, involving the swollen inguinal glands of the injected side. Such enlargement of the glands was distinct after 48 hours; grew more pronounced by the end of the week; and by the end of the second week could be recognised as a fluctuating abscess which, whether it opened spontaneously or was incised, led to a sore which soon healed up completely. The contents of the abscess consisted of thick, creamy pus, which, in microscopic specimens, exhibited pus cells and numerous large and small masses composed of short streptococcus chains matted together. These were by sub-culture shown to be of the same kind as those used for experiment.

Cultural characters of the microbe:—The microbe grows well at 37° C.; it grows also at 20° C., though, of course, slower. Its colonies on the surface of gelatine are characteristic: After a few days incubation, the colonies appear as grey, translucent round discs, which under a glass exhibit a dark, granular centre, and a filmy rounded peripheral part. Densely-placed fine radial striæ extend from the central granule to, and here and there beyond, the periphery, so that the outline of the colony is slightly crenate, or toothed. The colonies during the next few days continue to grow in breadth, but they retain their striated character. Since this fine radial striation distinguishes this particular microbe from other known streptococci, I propose to name it *streptococcus radiatus pyogenes*, there being already known a streptococcus (liquefaciens) radiatus of flügge. This latter microbe, besides liquefying gelatine, has no pathogenic action on rodents, whereas

the microbe now in question does not liquefy gelatine at any time, and, as has been already mentioned, has definite pathogenic (pyogenic) action.

In the stab of gelatine, the microbe forms along the line of the stab a row of isolated granular colonies, white in reflected brownish in transmitted light; on the surface of the stab there is only slight growth in the form of a small filmy particle. In broth at 37° C., the growth is very characteristic, and distinguishes this microbe from streptococcus pyogenes; viz., it forms greyish white flocculent masses at the bottom of the tube, the remainder of the broth remaining clear. In this respect it closely resembles the streptococcus (conglomeratus) scarlatinæ. The flocculi are consolidated masses of streptococcus.

On the surface of agar and of solidified blood serum, incubated at 37° C., the growth is rapid, forming round, flat, disc-shaped colonies, with thicker centre and translucent, slightly irregular, broad, filmy, marginal part.

In milk, the microbe grows well at 37° C. It does not alter the fluid character or aspect of the milk, though, when grown in litmus milk, it forms acid, turning the litmus red. The cultures lose their vitality rapidly, more rapidly on media that are kept at 37° C. than on gelatine-surface cultures at 20° C.; in gelatine stab it lives longest.

The cultural characters above described, together with the pyogenic action on the guinea-pig, show that this streptococcus radiatus is a definite species distinct from the streptococci hitherto described. The only species with which, owing to its derivation (from the inflamed udders of the cow), it might seem to have a relationship, is the streptococcus mastitidis of Nocard and Mollerau (Annales de l'Institut Pasteur I., p. 109), *i.e.*, the specific microbe of contagious purulent inflammation of the udder. But, apart from the marked difference of this streptococcus radiatus from that of Nocard and Mollerau in broth culture, there is its striking pyogenic action on the guinea-pig, a function not possessed by the S. mastitidis of the French observers.

Streptococcus radiatus pyogenes taken from cultures stains readily by Gram's method, a character possessed by many other streptococci. The individual cocci measure about 0·6–0·8 μ.

Amongst the samples of udder secretions, which looked like milk but which left at the bottom of the tube a thick purulent sediment, a particular sample yielded a sediment which, when injected into guinea-pigs, whether subcutaneously or intraperitoneally (June 12), caused death of the animal within 24 hours.*

On post-mortem examination of the intraperitoneally injected animal, the following condition was found: Copious purulent peritoneal exudation, intestines much inflamed, on the omentum thick continuous masses of pus. Stained cover film specimens of the peritoneal purulent fluid and of the pus of the omentum

* A Veterinary Inspector, who examined this cow's udder, had made the preliminary diagnosis of tuberculosis of the udder, but neither film specimens nor experiment confirmed this.

showed, besides pus cells, large numbers of large and small masses of bacilli, which in size, aspect and shape (some pointed at one end, many club-shaped) as also in the segregation of their protoplasm—(by which they appeared granular)—resembled, in a striking degree, diphtheria bacilli. The only difference ascertainable was that the bacilli in question did not stain readily in the ordinary dyes, whereas the diphtheria and diphtheroid bacilli are known to do so. These bacilli stained best by Gram's method.

A few drops of this purulent exudation were (June 13th) injected subcutaneously into the groin of a guinea-pig (a). Next day the animal was found quiet and off its feed, and there was present a gelatinous tumour extending from the groin over one side of the abdomen. On June 16th this swelling had increased, was painful to the touch, and the animal remained off its feed and quiet. On June 19th the tumour was still big, but the animal fed a little and was more lively. On June 21st the tumour was distinctly fluctuating, the animal having become fairly lively and feeding well. This guinea-pig was now killed. On post-mortem examination there was found in the groin a huge abscess the wall of which was adherent to the skin. On cutting into it a quantity of thick greenish pus was voided, which pus contained large numbers of whitish granules like curds. In film specimens there were, besides pus cells, dense masses of the above diphtheroid bacilli; the above named granules proved indeed compact masses of the bacilli. Only Gram-stained specimens showed these points well and clearly, ordinary stain was less useful. All the viscera were normal.

A few drops of pus from this inguinal abscess, previously diluted, were now injected, on June 21st, subcutaneously into two guinea-pigs (b) and (c), and into a third (d) intraperitoneally. Guinea-pigs (b) and (c), which were killed on July 18th, yielded quite negative results; the intraperitoneal animal (d) however, which was killed on July 12th, presented on post-mortem examination the following appearances. Next to its left kidney and joined to the capsule was an abscess of the size of a big filbert. This, when cut into, voided thick creamy pus, looking like clotted cream with numerous white granules. Film specimens stained by Gram's method yielded masses of the diphtheroid bacilli mentioned above. This series was continued by several further transmissions, both subcutaneously and intraperitoneally, and always with the same positive result, viz., production of local abscess full of the diphtheroid bacilli, many grouped in coherent masses.

Returning now to the guinea-pig subcutaneously injected with the original udder secretion on June 12th, and which (like its companion the intraperitoneally injected animal) died within 24 hours, this animal on post-mortem examination showed the following conditions. The inguinal glands of the injected side were swollen and deeply congested, and the subcutaneous tissue around them was much infiltrated by sticky thick purulent matter. Film specimens showed the diphtheroid bacilli in great abundance. The omentum appeared much congested and on it were lumps of solid lymph. Film specimens of this lymph, stained by Gram's method, showed an abundance of the same diphtheroid bacilli.

Cultivations were, after dilution with sterile salt solution, made of the purulent matter of all the subcutaneously and intraperitoneally injected guinea-pigs hitherto mentioned, on a variety of media—ordinary agar, glucose agar, glycerine agar—and the result in each instance was an abundant crop of colonies, which under the microscope and in Gram-stained film specimens were of the same species, viz., the above mentioned diphtheroid bacilli. From these colonies subcultures were then made in various media and the cultural characters of the microbe thereby carefully studied. These are as follows :—

The microbe is non-motile, and grows considerably slower at 37° C. than bacillus diphtheriæ. It does not grow on nutrient gelatine at 21° C. The colonies on agar, glycerine agar, and solidified blood serum do not appear until after two or three days incubation. On agar and glycerine agar they are small grey dots, which grow later into circular flat discs showing a dark granular centre and a translucent somewhat angular margin; but at no time are the colonies of the size of those of the diphtheria bacillus under the same conditions. The microbe shows no growth in stab culture in agar or glycerine agar. In milk, and on the slanting surface of solidified blood serum, the growth is characteristic and quite different from that of the bacillus diphtheriæ and other known diphtheroid bacilli. Ordinary milk inoculated with the microbe and incubated at 37° C., shows by the third day, commencing coagulation and a gradual separation (at the bottom of the tube) of the casein from the clear whey; the top layer of cream remains unaltered. Litmus milk becomes red and shows the same coagulation and separation of the casein.

On solidified blood serum the colonies appear on the third day as small round granular colonies situated in a depression of liquefying serum. The surface of the serum looks as if pitted, each pit corresponding to a small round zone of liquefaction, and at the bottom of each pit is a small dark (in transmitted light) granular colony. The serum is gradually liquefied. The microbe of all cultivations stains best by Gram's method. These characters in culture—in milk and in serum—are sufficiently striking to distinguish this microbe from all other known diphtheroid bacilli. The microbe rapidly dies off in culture; it lives, however, longest in serum cultures. On account of its non-motility and its morphological resemblance to the diphtheroid bacilli I have named it *bacterium diphtherioides*.

A considerable number of experiments were made with the recent cultures of this micro-organism. Guinea-pigs were subcutaneously and intraperitoneally injected with several drops of liquefied serum culture, or with similar amount of the whey of milk culture, and in over fifty per cent. of cases the result was positive. An abscess developed, in the course of one, two, or three weeks, which contained thick grumous pus with numerous white granules; while the pus in general, and particularly the above-named granules, contained the bacterium diphtheroides in abundance.

Subcutaneous inoculation of white mice proved negative.

From the above observations it follows then that the milk obtained from cows in which one or the other portion of the udder is affected might contain either of the two microbes—streptococcus radiatus or bacterium diphtheroides; and that since these micro-organisms are capable of causing a specific pyogenic process, such milk may itself become the cause of pyogenic process also in the human subject.

Butter.

The next food stuff submitted to analysis in respect of the presence or absence of tubercle bacilli, bacillus pseudotuberculosis, or other microbe capable of pathogenic action, was butter, samples of which were bought in various retail shops.

The samples were of the following description :—

(1) Best Normandy butter;
(2) Best Brittany butter;
(3) Irish butter;
(4) Australian butter;
(5) French butter;
(6) Dorset butter.

Of each of these, two samples were analysed.

With this object a quarter of a pound of the butter in each case was placed in a sterile flask along with 120–150 cc. of sterile salt solution. This mixture was then placed in a water bath kept at a temperature of about 30-35° C. By constantly shaking the fluid the butter soon melted, and the contents of the flask formed a milk-like emulsion. This was then poured into a sterile large conical "urine glass," which was placed in the ice chest till next morning. By this means the whole of the particulate matter of the butter had settled, as a smaller and larger amount of a powdery precipitate, in the lower or pointed part of the glass; above it was a slightly turbid fluid, and on the top the solidified remains of the butter. After removing the superficial solidified fat by means of a sterile spatula, and then carefully decanting the turbid fluid, the sediment could be easily collected and used for injection of guinea-pigs.

[As with milk, I have satisfied myself that by this simple method of sedimentation "in the cold" practically all particulate foreign matter can be obtained from the butter; for by melting and shaking the butter in sterile salt solution there is thoroughly washed out of it all particulate foreign matter, and by further keeping the mixture in the ice chest the particulate matter has time and opportunity to collect at the bottom of the fluid.]

This sediment, which in each instance contained practically all particulate foreign matter of the sample, was injected half of it subcutaneously into one guinea-pig, the other half intraperitoneally into another guinea-pig. As a result, with the twelve samples

of butter ($\frac{1}{4}$ pound of each) twelve guinea-pigs were injected subcutaneously and other twelve intraperitoneally. The outcome of these experiments was as follows :—

1. *Experiment.*—Sample 1, Normandy butter; guinea-pig No. 1 injected intraperitoneally, guinea-pig No. 2 subcutaneously.

    Sample 2, Normandy butter; guinea-pig No. 3 injected intraperitoneally, guinea-pig No. 4 subcutaneously.

The animals No. 1 and No. 2 were killed 27 days after injection. On post-mortem examination No. 1 had a small closed abscess in the omentum ; all the other viscera were normal. The pus of the omentum showed no tubercle bacilli or other acid-fast bacilli, nor any pseudotubercle bacilli; but it contained numbers of staphylococci which on culture proved to be staphylococcus pyogenes aureus.

Guinea-pig No. 2 had a closed abscess in the abdominal wall of the inguinal region, the pus of which abscess contained no tubercle bacilli, no other acid-fast bacilli, and no pseudotubercle bacilli; it contained, however, staphylococcus aureus, just like the pus of the first animal. All the viscera appeared normal.

The two animals No. 3 and No. 4 were killed 28 days after injection. There was nowhere any lesion to be found, and the viscera were normal in both animals.

2. *Experiment.*—Sample 1, Brittany butter; guinea-pig No. 5 injected intraperitoneally, guinea-pig No. 6 subcutaneously.

    Sample 2, Brittany butter; guinea-pig No. 7 injected intraperitoneally, guinea-pig No. 8 subcutaneously.

All four guinea-pigs (in the two sets) were killed; the two intraperitoneally injected animals after 30 days, the two subcutaneously inoculated animals after 50 days. The result was wholly negative; there was no lesion found, either locally or viscerally.

3. *Experiment.*—Sample 1, Irish butter; guinea-pig No. 9 injected intraperitoneally, No. 10 subcutaneously.

    Sample 2, Irish butter; guinea-pig No. 11 injected intraperitoneally, No. 12 subcutaneously.

Guinea-pig No. 10 was found dead after 20 days, but there was no lesion anywhere to be discovered in it, and the cause of death could not be detected. Guinea-pig No. 9 was killed after 30 days; no lesion anywhere; viscera normal.

Guinea-pig No. 11 was killed after 30 days; no lesion anywhere; viscera normal.

Guinea-pig No. 12 was killed after 38 days; no local lesion; viscera normal.

4. *Experiment.*—Sample 1, Australian butter; guinea-pig No. 13 injected intraperitoneally, No. 14 subcutaneously.

    Sample 2, Australian butter; guinea-pig No. 15 injected intraperitoneally, No. 16 subcutaneously.

The two intraperitoneally injected guinea-pigs were killed after 30 days; the two subcutaneously inoculated animals after 38 days. The result in each instance was wholly negative.

5. *Experiment.*—Sample 1, French butter; guinea-pig No. 17 injected intraperitoneally, No. 18 subcutaneously.

Sample 2, French butter; guinea-pig No. 19 injected intraperitoneally, No. 20 subcutaneously.

The two intraperitoneally injected guinea-pigs (No. 17 and No. 19) were killed after 30 days, the two subcutaneously inoculated animals (Nos. 18 and 20) after 43 days. All four animals were found normal; viscera normal; no lesion anywhere to be discovered.

6. *Experiment.*—Sample 1, Dorset butter; guinea-pig No. 21 injected intraperitoneally, No. 22 subcutaneously.

Sample 2, Dorset butter; guinea-pig No. 23 injected intraperitoneally, No. 24 subcutaneously.

The two intraperitoneally injected animals (Nos. 21 and 23) were killed after 21 days; the two subcutaneous inoculated animals (Nos. 22 and 24) after 31 days. The result was wholly negative; no lesion anywhere to be found.

From these experiments it follows, then, that of 24 animals injected from 12 samples of different butters—using the particulate matter of one-eighth of a pound for injection of each animal—no tubercle, no pseudotubercle, nor any other diseased condition was produced in 21 animals; one died from an unknown not discoverable cause; and two animals, injected from the same sample of butter, showed a local abscess due to staphylococcus aureus.

These results, therefore, contrast very favourably with those of other observers. For instance Rabinovitsch, found in 28·7 per cent. of butter samples in Germany and in Philadelphia the acid-fast pathogenic bacilli referred to on a previous page. Other Continental observers, too, like Brusaferro, Roth, Schuchard, and Gröning, found virulent tubercle bacilli in samples of butter, varying in amount between 10 and 47 per cent.

Margarine.

From three different stores samples of margarine were procured.

These samples, which differed in price, may be classed as dear, medium, and cheap. Of each kind, on two separate occasions, purchases were make; so that altogether six samples of margarine were examined. In each experiment a quarter of a pound of the material was treated exactly in the same way as was adopted with the butter samples, viz., the sediment of the washing in about 120–150 cc. of sterile salt solution (after the melting of the quarter of a pound of the material) was collected and injected, half into one guinea-pig subcutaneously, and half into a second guinea-pig

intraperitoneally. All twelve animals were kept under observation for three months, but all appeared quite well. They were then killed. On post-mortem examination they presented no lesion of any kind, either locally or generally.

This, as far as it goes, compares not unfavourably with the results of other observers. Morgenroth (Hygienische Rundschau, November, 1899) found tubercle in nine out of 20 samples of Berlin margarine; Annett (Thompson-Yates Laboratory, Vol. II., p. 34) found tubercle in one out of 15 Berlin samples, and in one out of 13 Liverpool samples. I have said my results compare not unfavourably because, although in my experiments fewer samples of the material were analysed, considerably more was injected into each animal. Annett, for instance, injected 5 cc. of the melted material, whereas in these experiments there was injected the washing of one-eighth of a pound per animal. Further, the fact that not a single one of the 12 animals experimented with died, whereas in Annett's case 21 out of 36 Berlin samples caused death of the injected guinea-pigs within 10 days, shows that the material here worked with was more free of obnoxious admixture than the Berlin material.

Tinned Food Stuffs.

All the samples coming under this head were examined for the presence of bacillus coli, of coli-like microbes, of pathogenic anaerobes, and of pathogenic cocci. With this object a fair amount of the materials (not less than a platinum loopful) was used for making phenol gelatine surface plates, phenol broth cultures, and anaerobic milk cultures. The first medium served for the isolation of bacillus coli, of coli-like organisms, and of other microbes capable of growing on phenol gelatine; the second had the advantage that from it further subcultures in plates could be established; and the third, viz., anaerobic milk cultures, were made in order to detect the presence of anaerobic bacilli, whether pathogenic or non-pathogenic.

Condensed Milk.

Of this material eight samples were examined. Four of these were bought as of "superior," the other four as of "inferior" brand. The result of the examinations was as follows:—

All samples proved non-sterile; they contained a considerable number of microbes which proved to be cocci. All the "inferior" brands contained these more numerously than the "superior" brands, inasmuch as the plates made with a platinum loopful of the materials from the inferior brands yielded inumerable colonies, whereas those made with a similar amount of the superior brands, though showing abundant growth, yielded colonies that could with care and patience be counted.

The superior brands yielded non-liquefying white staphylococci; the inferior brands yielded liquefying staphylococci, some white

others yellow. These last looked in culture like ordinary staphylococcus aureus, whereas the first looked like staphylococcus albus. A large number of subcutaneous injections of guinea-pigs were made with pure cultures of all the cocci isolated, viz., with the non-liquefying white staphylococci of the superior brands, as also with the liquefying white and yellow staphylococci of the inferior brands. But all these experiments proved negative. The animals, it is true, showed slight swelling at the seat of inoculation within 24 hours; but this had disappeared after 48 hours. This first swelling was no doubt due to the large amount of material injected; in each case the emulsion of the whole growth on the surface of an agar tube. At no time was there observed any change in the condition of the animals. They were killed at periods varying from one to four weeks after injection. On post-mortem examination no lesion of any kind could be found either locally or generally.

Except as regards cocci the condensed milk samples were free of microbes; the materials yielded no bacillus coli or coli-like organisms, and contained no spores of anaerobes, pathogenic or non-pathogenic.

Tinned Salmon.

Four samples of tinned salmon were analysed; two of "superior" brand, two of "inferior" brand.

The result was that no sample contained bacillus coli or any coli-like microbe, and that no sample contained spores of any anaerobe, either pathogenic or otherwise. But a plate made by rubbing a considerable amount of the material over the surface of phenol gelatine, yielded in the case of one sample (superior brand) two colonies of a non-liquefying and two colonies of a liquefying white coccus. Neither of these, however, possessed pathogenic action.

Tinned (potted) Ham.

Four samples were analysed; two of "superior," and two of "inferior" brand. Phenol agar plates, made by rubbing over the surface of the agar set in a plate dish a particle of the ham of about the size of a pea, yielded large numbers of colonies; so that the materials were anything but sterile. Amongst these colonies the predominating microbe was a small bacillus, which on culture proved without any pathogenic action on rodents, though injected into them in large doses subcutaneously and intraperitoneally. Another microbe isolated was a large coccus, not unlike a sarcina; but inoculation of guinea-pigs with the culture of this proved without any effect. None of the samples of the ham contained either bacillus coli or any coli-like microbe; nor did they contain any spores of anaerobic bacilli.

Other Preserved Food Stuffs.

The next series of analyses refer to articles of food which, although not tinned, may yet be considered as coming under the term "preserved," since they are kept in shops for indefinite time

in a prepared or cooked state, ready for immediate consumption. These were (a) pies, (b) German sausage, (c) black pudding. Analysis of these articles was carried out in exactly the same manner as with tinned articles, viz., search was made for the presence of bacillus coli, of other coli-like microbe, for spores of anaerobes, and for other pathogenic cocci or bacilli. The result was as follows :—

Pies.

From an ordinary ham and beef shop, on different occasions, two 8*d*. pies and two 2*d*. pies were bought and analysed. None contained bacillus coli or other coli-like microbes; and none contained the spores of any pathogenic anaërobe. But all contained the spores of anaërobic non-pathogenic bacillus butyricus. Also all contained the spores of bacillus mesentericus vulgatus, and staphylococcus albus of at least two different kinds, both of them non-liquefying and non-pathogenic.

In addition to these microbes, there was isolated from one of the 2*d*. pies a bacillus which, in morphological respects, resembled the xerosis or pseudodiphtheria bacillus, though it differed therefrom in growing conspicuously slower on agar at 37° C. and on gelatine at 20° C. It grows well on serum solidified with slanting surface. Its culture proved without any effect on the guinea-pig, even when inoculated in large doses.

German sausage.

Three samples of this article were bought on three different occasions at the same retail shop ; assurance being given that they had not been derived from the same sausage makers. None of these samples contained bacillus coli or coli-like microbes. None of them contained the spores of virulent bacillus enteritidis. But all contained the spores of the non-pathogenic anaërobic bacillus butyricus of Botkin.

A large number of colonies came up in the *aërobic* phenol agar plates, most of them being sporing, motile bacilli, belonging at least to five different species. Amongst these colonies there were, however, a few which in aspect and mode of growth resembled those of the typhoid bacillus to a very marked degree. Examined under the microscope in the hanging drop, from a recent subculture in sterile bouillon, they were seen to be composed of cylindrical and filamentous bacilli which, in respect of size, shape, and very active motility—serpentine motion of the filamentous bacilli—strikingly resembled typhoid bacilli, taken from a recent subculture and examined under the same conditions.

Subcultures were made of these colonies on gelatine, on agar, in broth, in milk, and in litmus milk : And it was found (a) that these microbes do not curdle milk, but form acid ; (b) that they do not form indol in broth, and do not produce gas in gelatine or in glucose gelatine. So that in respect not only of morphological characters but also of behaviour in milk, in litmus milk, in broth culture, and in gelatine shake culture, the resemblance of this bacillus

to the typhoid bacillus was very strong. On gelatine streak, however, the growth of this microbe, though as translucent as that of the typhoid bacillus, differed markedly from the latter by the growth not having much tendency to spread beyond the actual streak of inoculation. In conformity with this, the growth in the streak culture of the microbe in question becomes, as time goes on, less translucent and more whitish in reflected light than is the case with the control typhoid bacillus culture. In addition, while the typhoid bacillus never at any time shows any trace of liquefying the gelatine, this microbe, after several weeks growth, causes a softening and slight liquefaction of this medium. This microbe grows well in phenol broth and on phenol agar, but both on phenol agar, as also on ordinary nutrient agar, kept at 37° C., it forms oval spores in a day or two; a character certainly not possessed by the typhoid bacillus. The same spore formation is also observed in gelatine streak cultures after several weeks, *i.e.*, when the gelatine has commenced to soften.

While this spore formation leaves little doubt that the microbe in question is a wholly different species from the typhoid bacillus, from bacillus coli, and from all coli-like microbes, there is the further fact that it possesses (just like a similar culture of the true typhoid bacillus) the remarkable character of becoming readily agglutinated by typhoid blood.

The following experiment show this:

A bouillon emulsion was made of a gelatine culture of this bacillus, 48 hours old. This emulsion showed the microbe in the form of cylindrical and shorter or longer filaments actively motile. To the emulsion there was added, in the proportion of 1 to 50, blood from a case of typhoid fever which had in the same proportion (1 to 50) agglutinated well and rapidly (in 5 to 10 minutes) a control emulsion of a gelatine culture of the true typhoid bacillus. As a result, agglutination was complete in 10 minutes.

As a second experiment, the above emulsion was tested with the blood of a guinea-pig which had been immunized by two successive subcutaneous injections of small doses of living typhoid bacillus culture. A fortnight after the second injection of this guinea-pig, its blood, in the proportion of 1 to 50, was added in each instance to emulsions of growth on gelatine (48 hours old) of the typhoid bacillus and of the bacillus from German sausage. Agglutination was complete in 10 minutes in both cases.

This bacillus therefore from German sausage stands in exactly the same relation to the typhoid blood test as does the Gärtner bacillus, since the latter suffers also agglutination by typhoid blood in the above proportions.

I next proceeded to immunize a guinea-pig with culture of the sausage microbe. A recent culture on gelatine (48 hours old) was rubbed down in sterile salt solution, and the whole mixture injected subcutaneously into the groin of a guinea-pig. This animal developed in the course of three to five days a slight swelling in the groin associated with an enlarged lymph gland; but the animal remained otherwise lively and well. Between February 21st and March 28th, the animal was five times injected in this way, each

time with a whole gelatine culture of the microbe. Its blood was now tested on the "sausage" bacillus, *i.e.*, the microbe with which it had been immunized. As a result, there was good clumping in 30 minutes, complete clumping in one hour; the dilution being as before 1 in 50. The blood of this immunized guinea-pig was at the same time tested on an emulsion of the true typhoid bacillus (dilution 1 to 25); but no result followed, no clumping even after 24 hours.

It is quite obvious from these experiments that this microbe from German sausage has no relationship to the typhoid bacillus; that it is in the same category with other bacilli on which the typhoid blood is capable of exerting its remarkable agglutinating action. This bacillus, therefore, deserves to be kept in mind, since it is now usual to finally test the bacilli of a given colony resembling typhoid bacillus—as, for instance, in aspect, in size, in motility, in milk, and in shake-gelatine and broth—by the agglutinating action on it of typhoid blood. By the aspect of its colonies on phenol agar and phenol gelatine plates, particularly by its appearance and motility in the hanging drop, further by its forming acid in litmus milk, by its not curdling milk, by its not giving indol test in broth culture, and last but not least by its showing marked and rapid agglutination with typhoid blood (1 : 50) this sausage bacillus would pass easily as the true typhoid bacillus. Careful further examination, however, would prove that it slightly liquefies gelatine after several weeks; that it does not spread out in the streak on gelatine like the typhoid bacillus; and above all that it forms distinct oval spores on agar after 24–48 hours. Finally that the blood of a guinea-pig previously injected several times with it has no agglutinating action on the true typhoid bacillus.

I propose for this microbe the name of *bacillus pseudotyphosus*, and would particularly draw attention to its characters as above described.

Black Pudding.

This article corresponds to what the Germans call "Blutwurst." Three samples bought on three different occasions at the same retail shop were examined. These samples contained no bacillus coli or coli-like microbes. But there were present at least three kinds of bacilli, namely:—(*a*) sporing motile mesentericus vulgatus (*b*) non-sporing, non-motile, non-pathogenic cylindrical bacilli; and (*c*) long filaments forming oval spores at regular distances, non-pathogenic. The samples also contained the spores of an anaërobic gas-producing bacillus, which curdled milk like the bacillus butyricus while differing from this microbe in that its thinner filamentous bacilli produced gelatinous mucus-like flocculi in the separated whey. Culture of this anaërobe proved without any effect on rodents. I propose to call it *bacillus mucosus*.

From these experiments it is seen that the examined samples of preserved food stuffs, though containing relatively numerous microbes belonging to various species, both aërobic and anaërobic, did not contain any organisms that had distinct pathogenic action on rodents.

PP. B, No. 2.
Bacteriological Analysis of Food Stuffs; Dr. Klein, F.R.S.

ADDENDUM.

A Pathogenic Blastomycetes obtained from Milk.

In the fresh state the cells appear surrounded by a thick capsule; their contents are a clear plasma in the peripheral part, a granular mass in the centre. The cells stain readily in all anilin dyes; and when so stained show a deeply stained thick capsule, with the whole cell contents, except the very marginal part, also deeply stained. Outside the capsule there is a faintly stained homogeneous substance by which the cells are connected together and aggregated into continuous masses (Fig. 4, Plate II). This interstitial substance is, I presume, of a gelatinous viscid character, since when the cells making up the aggregations are mechanically separated they appear still joined together by threads of the interstitial substance. It is difficult indeed, on account of the presence of this interstitial substance, to separate from one another the individual yeast cells, whether from the tissue of the tumour of the experimental animal or (and to an even less degree) from the smeary viscid masses which the growth forms on artificial culture media. Even thorough shaking up in salt solution leaves the masses still as coherent aggregations of yeast cells. The yeast cells in the tumour, as also in the cultivations on artificial media, stain well by Gram's method—gentian violet anilin water, 1 minute; iodine iodide of potassium, 4 minutes—the cells retaining the violet colour very well (Fig. 5, Plate II).

From the tissue of the tumour in the experimental animal artificial cultures were made on alkaline media: gelatine, agar, glycerin agar, glucose gelatine, glucose agar, ordinary nutrient broth, glucose broth, solidified serum, and potato. The cultures thus made from the tumour—using for inoculation the platinum needle dipped into the gelatinous semi-fluid tissue of the tumour which was thus transferred on to or into the culture medium—all succeeded and yielded pure growths of the blastomycetes. There appeared in these cultures no other colonies no cocci and no bacilli. This had already been deduced from the examination of the numerous stained film specimens made from the tissue of the tumour, since these showed nowhere any other microbe besides the yeast cells.

Inoculations into the subcutaneous tissue of the groin of guinea-pigs were likewise made directly with the tissue of the tumour, and they all yielded positive results, producing the same kind of gelatinous tumour as before. To these experiments I shall return presently after describing the cultural characters of the microbe.

Cultural Characters of the Blastomycetes.

The microbe grows well in all ordinary slightly alkaline media at temperatures between 20° and 37° C. It grows much less readily in slightly acid media, *e.g.*, wort broth or wort gelatine; it does not produce acid; on the contrary, litmus milk or litmus broth remain blue. On solid media—agar, gelatine, solidified serum, potato—it forms a cohesive viscid sticky growth, which, when a particle is placed in water or salt solution and shaken, does not become readily distributed but remains in coherent masses and flocculi. This, as has been mentioned, is due to the presence of a gelatinous interstitial substance binding together the yeast cells.

On ordinary nutrient gelatine and ordinary nutrient agar the growth is less copious than on glucose gelatine, glucose agar, and glycerin agar. The ordinary gelatine is very slowly liquefied by the growth; in the first few weeks no liquefaction is observed in the ordinary gelatine, but after several weeks' growth the colonies produce a softening of the medium. Later, the latter becomes slowly and gradually changed into a thick fluid of a syrupy consistency. On glucose gelatine the softening and liquefaction is somewhat quicker, although here also it is slow. The growth, both on ordinary gelatine and on ordinary agar, is, in streak, a thick band, whitish in transmitted light; in glucose gelatine and in glucose agar the growth, as mentioned above, is more copious, and assumes, after

some days, a distinct yellowish tint. The microbe does not grow in the depth of the solid media. For instance, in stab-glucose gelatine, or in stab-glucose agar, there is hardly any growth along the track of the needle, whereas on the surface of the medium (*i.e.*, the upper end of the stab) there is a copious thick layer of growth. The microbe is therefore a manifest aërobe. In no medium does it form gas, and it does not ferment glucose either in solid or fluid media. In broth and in glucose broth the microbe shows growth more feebly; forming, after some days at 37° C. in ordinary broth copious, in glucose broth a small amount of a whitish-grey powdery precipitate, while the liquid remains fairly clear. In glucose broth there is indication of pellicle. In milk the growth is copious, though the milk remains fluid and unchanged. The aspect of the colonies are shown in Figs. 1, 2, and 3, Plate I. They are round, somewhat raised in the centre, whitish in reflected, brown and granular in transmitted, light. On potato the growth is a sticky, moist, yellow brown, and has a tendency rapidly to spread over the surface. Examined under the microscope the growth from all media consists of pure spherical yeast cells, numerous individuals being met with in the process of gemmation. The capsule is well marked. There are at no time any of the cylindrical or hyphæ-like forms which frequently occur in the affected tissues of the infected animal. The microbe is pathogenic to guinea-pigs, rabbits, and mice, as is shown by the following experiments:—

Experiment 1.—With a few drops of an emulsion of the tissue of the inguinal tumour of the guinea-pig (No. 1), from which the blastomycetes were first obtained, guinea-pig No. 2 was, on 15th March, subcutaneously injected in the groin. A week later, March 22nd, a distinct nodule could be felt at the seat of inoculation. In other two days, March 24th, a further nodule could be felt next to the first. By March 30th the above nodules had become considerably enlarged. On April 5th examination revealed one big soft tumour in the groin, with another next to it, and extending well into the sacral region. Both tumours were fluctuating. An incision was made into one tumour, under aseptic precautions, with the result of obtaining a large quantity of grumous, grey, gelatinous, semi-fluid matter streaked with blood. It was at the same time ascertained that the two tumours—front and back—really communicated by a narrow neck. The tumours, by squeezing, were completely emptied, and the wound dressed antiseptically. The above grumous matter consisted of leucocytes and continuous large masses of yeast cells, exactly similar to those described above; the hyphæ-like cylindrical forms were here fairly numerous, as also pear-shaped and oval large forms of yeast cells. Cultivations were made of the grumous matter on different media, using, of course, traces only for inoculation, and it was found that all the cultivations yielded pure growths of the blastomycetes.

This guinea-pig (No. 2) completely recovered; the wound healed up rapidly, and in about three weeks (April 28) after there was no trace left. This same animal was, on May 1st, re-inoculated, this time with a good dose of active culture into the peritoneum. As will be presently shown, intraperitoneal injection of culture tends, ordinarily without fail, to a fatal issue. But this guinea-pig (No. 2) appeared none the worse for the second (intraperitoneal) injection; until September 5th it remained perfectly well. It appears, therefore, that the first local disease had furnished the animal with immunity against a fatal injection.

With the grumous material of the inguinal tumour of guinea-pig No. 1 guinea-pig No. 3 was injected, intraperitoneally, on April 5th. This animal seemed to be getting thinner towards the end of April, and it died on May 11th, *i.e.*, five weeks after injection. On post-mortem examination the following condition was found:—The omentum contained several whitish-grey nodules; the peritoneum around the testis was greatly congested, in the epididymis and around it were several whitish streaks and nodules; the liver and spleen seemed normal; the upper lobes of both lungs were deeply congested, and looked almost hepatised. Microscopic examination and cultures of the nodules of the omentum, of congested upper lobe of the lung, and of nodules around the testis, showed copious presence of the blastomycetes. The blood of the heart, however, yielded in cultivation no colonies.

Experiment 2.—Inoculution of guinea-pigs with culture of the blastomycetes on March 22nd.

(*a*) One guinea-pig (No. 4) was inoculated subcutaneously from a recent culture on ordinary agar.

One guinea-pig (No. 5) was inoculated intraperitoneally with the same culture.

(*b*) One guinea-pig (No. 6) was inoculated subcutaneously from a recent culture on glucose agar.

One guinea-pig (No. 7) was inoculated intraperitoneally with the same culture.

In these instances a small particle of the growth was distributed in a few cubic centimetres of sterile salt solution, and several drops of the emulsion were used for injection of each of the four animals.

Both animals (No. 4 and No. 6) subcutaneously injected, showed after eight days (March 30th) distinct swelling at the seat of inoculation.

Animal No. 4 died April 4th, *i.e.*, 13 days after injection. On post-mortem examination it showed in the groin a big gelatinous mass with hæmorrhage; no disease of any viscera. Cultures were made, each with a drop of the heart's blood, which on incubation yielded each about a dozen colonies of the blastomycetes. Microscopic examination and culture of the gelatinous tumour of the groin showed copious presence of the blastomycetes.

Animal No. 6 had on April 5th, *i.e.*, 14 days after injection, a big soft tumour extending from the pubis high up into the epichondrium. On April 9th, *i.e.*, 18 days after injection, the tumour was of the size of a hen's egg, and extended over the upper part of the thigh and groin, both in front and at the back, the animal being very ill and almost cold. It was killed, and presented the following condition on post-mortem:—The tumour was like firm jelly and involved the deeper parts of the skin and the subcutaneous tissues. When cut into the tissue looked like blood-streaked bacon in the peripheral part, the central part was a semi-fluid jelly. Under the microscope abundance of yeast cells in masses were found in all parts of the tumour; while the culture test gave pure growths of the blastomycetes. Besides the typical spherical yeast cells numerous cylindrical hyphæ-like forms were met with. Two cultures, made each with a drop of the heart's blood, yielded 8 and 22 colonies of blastomycetes respectively.

Both guinea-pigs Nos. 5 and 7 exhibited no symptoms until April 5th, *i.e.*, for 14 days. In the evening of this day they were found quiet and not feeding. On April 6th, in the morning, both were found dead. The body in each instance was inflated ad-maximum, the abdomen feeling tense like a drum. On post-mortem examination the stomach and intestines were found extremely distended by gas. In the wall of the stomach and large intestine there were numerous hæmorrhagic patches, the centre in each instance occupied by a whitish nodule, which on careful examination was found located in the mucous membrane. The omentum and pancreas contained numerous white nodules and patches surrounded by congested tissue. The peritoneum around the uterus and ovaries was deeply congested and contained numerous whitish nodules. Both lungs showed numerous petechiæ, and the tissue of the lung was full of gas bubbles. Microscopic specimens of the nodular masses of the stomach, large intestine, omentum, peritoneum around uterus, and of the tissue of the lung, showed abundance of blastomycetes cells, amongst them the cylindrical hyphæ were fairly abundant. Cultivations made from the nodules of all the above organs yielded pure growths of the blastomycetes. A drop of the heart's blood yielded in culture about a dozen colonies of the yeast. The abundance of gas in the stomach, intestines, and lung was an unexpected condition, since the microbe does not produce in any culture medium (with or without glucose) gas or any sign of fermentation. Yet in the dead bodies of the above animals—as also in other guinea-pigs injected intraperitoneally with culture and showing the same appearances as the above two animals—there was intensive evolution of gas. Whether this fermentation in the dead bodies is due to the presence in them of a fermentable substance not present in the culture media is a point which I have not been able to discover. This much, however, is certain, namely, that while the animal is alive there is no indication of a fermentative gas evolution.

A considerable number of other experiments were made by subcutaneous as well as by intraperitoneal injection of small amounts of culture (on gelatine, agar, serum, milk), the results of which were all positive and in all respects identical with those hitherto described. Sections were, after hardening the inguinal tumour, the stomach, intestine, lung, and epididymis, made of the nodular masses mentioned above, and by the ordinary methods of double staining it was shown that the tissue of the tumour and nodules consisted of leucocytes, and that masses of blastomyces cells, inclusive of the hyphæ-like forms, were easily demonstrated. Figs. 6 and 7, Plate II, and Figs. 8, 9, and 10, Plate III, show these points sufficiently distinctly.

Experiment 3.—Two mice were, on May 12th, inoculated subcutaneously with a few drops of an emulsion of a recent agar culture. Both animals were found quiet the next day; were off their feed, coats rough, eyes closed, and breathing rapid. After 48 hours one was found dead. On post-mortem examination the following condition was found:—The subcutaneous tissue was deeply congested about the seat of inoculation; the liver was congested and on section showed numerous whitish grey spots and patches; the spleen was much congested and enlarged; both lungs were deeply congested. Cultures were made from the heart's blood, the spleen, and the lung. All yielded pure growth of the yeast.

The second mouse remained ill for some days. It did not feed well and its coat was rough; but by the end of the month it had seemingly quite recovered.

Experiment 4.—Two half-grown rabbits were injected, each in the ear vein, with an emulsion of a recent agar culture, on May 12th. Nothing abnormal was noticed till May 26th—*i.e.*, a fortnight later. At this date they seemed quiet and were not feeding; and in this condition they remained with little change till June 7th, when it was noticed for the first time that one of the rabbits could not move its hind limbs. This animal by June 16th was quite paralysed in the hind part of its body; it died in the evening of same day. On post-mortem examination the following condition was found:—Bladder and large intestine greatly distended, the lumbar and lower cervical cord very congested both in its membranes and in its substance; the lumbar and, less conspicuously, the lower dorsal cord showed a number of small protuberances in which the white matter was softened and disintegrating. Fresh and stained film specimens made of the congested membranes and the white matter of the lumbar cord showed numerous yeast cells. Cultures yielded positive result.

The second rabbit showed the same paralysis of the hind part of its body, but later, about June 18th. It died on June 20th, and on post-mortem examination showed exactly the same conditions as its companion. In both animals the viscera appeared normal.

Sections of the hardened cord of the second rabbit were stained and mounted. On microscopic examination some extremely interesting changes were notified in the upper lumbar and lower dorsal cord, as follows:—

Transverse section through the lumbar and lower dorsal cord showed a mass of inflammatory tissue occupying exactly the position of Clarke's column of the right side of the cord; *i.e.*, the mesial portion of the posterior grey horn adjoining the grey commissure. This mass, which was circular in outline, showed a number of blood vessels densely surrounded by round cells, the intervening parts being occupied by a more or less granular debris. This mass was sharply marked off from the rest of the grey matter so that it looked like a new growth, the anterior grey horn of the same side being at the same time more or less disorganised and pushed forward ventrally; so much so that the white matter of the portion of the anterior and lateral column adjoining the antero-lateral fissure was bulging forward. In the anterior horn of this side there were no ganglion cells, whereas in the anterior horn of the opposite side the ganglion cells were distinctly visible. The part of the lateral white column corresponding to the direct cerebellar tract of the right (affected) side was greatly reduced in thickness.

In the middle portions of the above inflammatory tissue there were numerous yeast cells.

Similar inflammatory changes, round cell infiltration with yeast cells amongst them, were noticed in what corresponded to the spinal ganglia of these regions; of the ganglion cells nothing was left.

In Fig. 11, Plate III, and Figs. 12, 13, 14, and 15, Plate IV, the above changes are well shown.

Two further rabbits experimented with in the same manner, viz., intravenous injection of culture, yielded precisely like positive results.

Experiment 5.—In this series a number of guinea-pigs, rabbits and mice were on two separate occasions *fed* with food to which a large amount of culture of the yeast was added; particularly milk and glucose broth culture, but also the emulsion of scrapings of glucose agar culture. The animals remained perfectly well.

The result, then, of these experiments go to show that the blastomycetes of the milk sample is highly pathogenic when injected subcutaneously, intraperitoneally, or intravascularly into rodents; and that as far as these experiments go, guinea-pigs

The morphological and cultural characters of S. scarlatinæ when isolated from the tonsillar secretion in the mild type of scarlatina did not appear to be quite fixed in every instance, but were not infrequently found to be susceptible of modification. By passage through a mouse an alteration was apt to take place in one of two directions. Either (*a*) the morphological and cultural individuality of the streptococcus (especially the faculty of bacillus-formation) might occasionally become accentuated; or (*b*), more often the morphological and cultural individuality was diminished but remained sufficiently evidenced, especially in the way of forming spindles and bacillary forms, to differentiate the modified type of the organism recovered from a mouse from Streptococcus pyogenes. Accompanying this tendency to loss of morphological and cultural individuality there was found a marked increase of virulence in a proportion of the few cases where the point was tested.

The question as to how far the latter modified form of S. scarlatinæ recovered from the tissues of a mouse was capable of further modification had not been at all adequately determined at the time of writing last year's report. In one case, however, where it had been passed through a guinea-pig the faculty of bacillus-formation was now found to have become to some extent suppressed. A near approach to Streptococcus pyogenes was consequently arrived at in this particular instance.

A streptococcus obtained in pure culture from a serous effusion that occurred during an attack of scarlatina, and kindly given me by Dr. Hopwood, was found to eventually admit of identification with S. scarlatinæ, owing, among other characters, to the formation of spindles and bacillary forms in gelatine colonies after the organism had been cultivated on artificial media for some time.

The second stage of this inquiry, that is to say the bacteriology of the scarlatinal cadaver, was next entered upon. An investigation of the blood and organs after death from scarlatina was made in a total of 10 cases. The procedure consisted (1) in microscopical examination of the blood and organs with a view to observing any micro-organisms *in situ*; (2) in making cultures, generally aërobic, but supplemented in the case of the heart's-blood in several instances by anaërobic cultures; and (3) on several occasions a little of the actual heart's-blood from the scarlatinal cadaver was introduced subcutaneously into mice. The result of the investigation, however conducted, was that in every case a streptococcus was obtained, and often in pure culture. Anaërobic conditions developed no micro-organisms that were not found in aërobic cultures. The heart's-blood of the scarlatinal cadaver was harmful to mice in proportion generally speaking to the amount of streptococcus which it contained. If the organism was numerous in the human heart's-blood with which the mouse had been injected, it died in a few days of septicæmia, and from its blood and organs the same streptococcus was recovered. On the other hand, if the human heart's-blood contained only a few streptococci, or if no streptococcus was present, then the mouse was little, if at all, affected. Therefore, in the heart's-blood of the patient after death from scarlatina no evidence was found of

any harmful agent other than had already come to view by means of microscopical examination coupled with the culture method.

Up to this point the evidence obtained by the study of the scarlatinal cadaver was clear and striking. Here, however, there occurred a considerable difficulty. In only two of the ten fatal cases could the streptococcus in question be at once identified with S. scarlatinæ. In the remaining eight cases the streptococcus (present in some cases in large numbers) did not admit of immediate identification with S. scarlatinæ. Moreover, not only did the streptococcus most frequently recovered from the scarlatinal cadaver show several points of distinction from what I had considered typical S. scarlatinæ isolated from the tonsillar secretion in the mild type of the disease, but it also lacked several of the characters which distinguish that organism from S. pyogenes. Accordingly, for a long time, the evidence did not permit of a definite decision being drawn as to whether the streptococcus most frequently obtained from the scarlatinal cadaver was a modified form of apparently typical Streptococcus scarlatinæ, or an example of Streptococcus pyogenes. In favour of the former hypothesis was the fact that, in the single case where the modified form of S. scarlatinæ obtained from a mouse had been passed in addition through a guinea-pig, the resultant organism had been found to coincide in morphological and cultural characters with the streptococcus most frequently obtained from the scarlatinal cadaver. On the other hand this modified form obtained from the guinea-pig bore an unquestionable resemblance to Streptococcus pyogenes except that it showed rather more conspicuous conglomeration in broth culture, more "lace work" in agar condensation fluid, more bacillary forms in the last-named medium and also in agar colonies, than did examples of Streptococcus pyogenes with which comparison had been up to that time made. But, while the same points of variance with pyogenes were also shown by the streptococcus most frequently obtained from the scarlatinal cadaver, they did not seem to be by themselves sufficient to justify its identification with S. scarlatinæ.

Eventually, however, in three instances, the streptococcus most frequently isolated from the blood and organs of the scarlatinal cadaver developed, after continued culture, the faculty of producing spindles and bacillary forms in gelatine colonies. In these three instances the organisms were thus identified with the streptococcus recovered from the pleural effusion referred to previously. Indeed, they now presented actually more points of distinction from Streptococcus pyogenes than did the modified form of scarlatinæ obtained from the tissues of mice dead after infection with the organism as obtained from the tonsillar secretion of a mild case of scarlatina. I had, as a result, no hesitation in identifying these three examples of the streptococcus most frequently obtained from the scarlatinal cadaver with the type of streptococcus got from the scarlatinal tonsil in the mild type of the disease.

Viewing broadly the results thus far obtained, it seemed that much the same modification in the characters of Streptococcus

scarlatinæ might take place either when a mouse succumbed to infection with a pure culture of the organism isolated from the tonsillar secretion in the mild type of scarlatina, or when a patient succumbed to the more severe type of this disease. In each case S. scarlatinæ appeared to obtain enhanced virulence at the expense, to a great extent, of its morphological and cultural individuality.

So much, then, for the bacteriology of the blood and organs of five of the fatal cases of scarlatina in which the micro-organism present could, in two cases immediately and in three cases eventually, be identified with Streptococcus scarlatinæ. In the remaining five cases, on the other hand, identity of the streptococcus obtained from the cadaver with S. scarlatinæ could not be definitely established, although at the stage reached by the end of last year's report I was inclined to regard it as in all probability a form of that organism rather than of S. pyogenes.

There is another matter, however, which is of no little importance, and that is the question as to the site whence the fatal infection first enters the system. The evidence obtained on this point confirmed the view previously current, namely, that it was from the secretion on the surface of the tonsil and fauces that the fatal streptococcic invasion had spread. Streptococci in large masses were found in the neighbouring cervical glands in all five cases where sections of these organs were made, and in one case where sections of the tonsil were also made, the invasion of the tonsillar tissue by streptococci mostly in the form of diplococci was demonstrated. It was particularly noticed in this last case that the streptococci were spreading *viâ* the lymphatics.

The bacteria present in the secretion on the surface of the tonsil were investigated in three of the ten cases examined after death from scarlatina. In one of these three cases a streptococcus that could be immediately identified with S. scarlatinæ was obtained. On the other hand, no streptococcus immediately identifiable with S. scarlatinæ was obtainable from the other two cases; but there was present a streptococcus both in the tonsillar secretion, the blood, and other organs of the patients, which was identical with the streptococcus most frequently obtained from the scarlatinal cadaver. In one of these two cases an example of the same streptococcus isolated from the spleen was kept in culture and eventually identified with S. scarlatinæ; in the other of the two cases it was not possible to identify with S. scarlatinæ the organism present, from whatever source obtained.

The evidence, therefore, all points to the fatal septicæmia from which these scarlatinal patients had succumbed having been due to the inroad of a virulent streptococcus from the secretion on the surface of the tonsil, whence it spread by lympathic paths to the cervical lymph-glands and through them to the blood. It is worthy of note that the type of streptococcus most frequently obtained from the scarlatinal cadaver was in the two instances quoted above proved to possess while located in the secretion on the surface of the tonsil of the cadaver, and before it had actually entered the tissues, small morphological and cultural individuality, but marked virulence. Clearly, then, the most promise

of a correct understanding of the etiology of scarlatina lies in further and more precise study of the bacteriology of the secretion covering the tonsil during the course of an attack of the disease.

In last year's report this more detailed investigation of the bacteriology of the tonsillar secretion had been already begun. An attempt was made to examine the virulence as well as the cultural morphology of all the types of streptococcus present in cultures from this source. Controls were also made by examining in the same way both the normal as well as the inflamed but non-scarlatinal throat.

Details of two cases of scarlatina examined in this way were given. In one, case No. 54, eighth day since commencement of the attack of mild uncomplicated scarlatina, the agar plate, made from a dilution of the tonsillar secretion, showed Staphylococcus aureus and Sta. citreus, streptococcus medius, S. longus, and S. scarlatinæ. The virulence of each of the three streptococci was tested on a mouse. Medius produced death in one night, longus was apparently harmless, and scarlatinae produced local suppuration, but had not effected the death of the mouse on the fifty-second day, when the animal was killed. In the second case, No. 55, fifth week since commencement of the attack of mild uncomplicated scarlatina, the agar plate from the dilution of the tonsillar secretion showed Staphylococcus albus and Sta. citreus, Streptococcus longus, and S. scarlatinæ. The scarlatinæ of this case showed spindles and bacillary forms very prominently when growing on agar and on gelatine. Each of the streptococci obtained was injected into a mouse. The animal injected with longus was, apparently, quite unaffected, but that injected with scarlatinæ had local suppuration, and succumbed on the ninth day. Therefore, of these two cases of clinically mild and uncomplicated scarlatina, the first had a highly virulent form of medius or pyogenes present on the tonsil, together with a less virulent form of scarlatinæ and a non-virulent form of longus; while in the second case scarlatinæ alone of the two streptococci present was found to possess virulence for the mouse.

Control experiments were made as follows:—Streptococci isolated from the secretion of the normal tonsil, and bearing in one or more ways a morphological or cultural resemblance to S. scarlatinæ were injected into mice. In all instances the animal was, apparently, unaffected. From a case of ordinary tonsillitis, and from a case of follicular tonsillitis, examples of medius that possessed virulence sufficient to eventually bring about the death of the mouse were obtained. From a case of membranous pharyngitis, in which no diphtheria bacillus was found on two occasions, a very virulent example of Streptococcus brevis was obtained. In a case of diphtheria, a very virulent form of streptococcus medius was present, together with bacillus diphtheriæ.

From these results it appeared that while S. scarlatinæ had been shown to be constantly present in the throat in scarlatina, it had not been obtained from the four inflamed but non-scarlatinal throats examined. In three of these latter cases the virulent streptococci present were of the medius or pyogenes type, and in the fourth a virulent form of S. brevis was obtained. But while S.

scarlatinæ had not been demonstrated in the non-scarlatinal throat, Streptococcus pyogenes in a highly virulent condition might or might not be present, together with scarlatinæ, in the secretion on the surface of the tonsil, in a case that was clinically mild and uncomplicated scarlatina.

SECTION II.

METHODS and SCOPE of the PRESENT REPORT.

During the past year investigation has been continued on the lines indicated towards the end of the preceding section. Attention has been concentrated on the bacteriology of the secretion covering the tonsil in the mild and uncomplicated type of scarlatina. It is hardly necessary to remark that this is by far the commonest form of the disease at the present time.

The methods hitherto employed during the inquiry, and described in previous reports, have been continued in use except in two particulars. The first alteration, which was suggested to me by Dr. Houston, to whom my best thanks for it are due, consists in the approximate measurement of the dilution of the tonsillar secretion with which the initial cultures are inoculated. The measurement has been effected in the following way. It was found that the platinum loop used for the purpose of removing a droplet of the tonsillar secretion of the patient required to be three times charged in order that its contents might fill Hawkesley's 5 cm. ($\frac{1}{200}$ of a cc.) pipette. Thus the capacity of the loop is a little under $\frac{1}{500}$th of a cc. Accordingly the procedure adopted has been to distribute two loopfuls of the tonsillar secretion of the patient in two cubic centimetres of sterile salt solution. 1 cc. of this dilution thus contains one loopful, or a little under $\frac{1}{500}$ cc., of the tonsillar secretion; and two loopfuls of the dilution represent $\frac{1}{250}$ of $\frac{1}{500}$ cc., or $\frac{1}{125,000}$ cc. of the tonsillar secretion. A culture inoculated with two loopfuls of the dilution, therefore, has been considered to have been inoculated with a dilution representing approximately $\frac{1}{100,000}$ of a cc. of the tonsillar secretion of the patient; and all organisms therein developing must have been present in the tonsillar secretion to the extent of at least one hundred thousand per cc. The calculation is, of course, only an approximate one, but the error is, so far as can be seen, in the right direction, that is to say, the amount of tonsillar secretion represented in the dilution is below the figure taken. To obtain more minute quantities of the tonsillar secretion the original dilution is further diluted. In examining the tonsillar secretion both in scarlatina and in other conditions by this method I have made the dilutions as far as possible in the same fashion, so as to render the results parallel. It may here be added that although use of measured dilutions of the tonsillar secretion has been made in at present comparatively few cases, it is a procedure that is to be recommended, both on account of the additional information which it affords, especially with regard to the relative abundance of organisms, but also because of the sound basis which it offers for the purpose of comparative observations.

The introduction of the quantitative method, however, is not the only change that has been effected. Another fresh point of departure has been the substitution of solidified blood-serum (horse's) for agar, as an initial medium for the cultivation of micro-organisms from the tonsillar secretion. One of the chief reasons for using serum instead of agar as an initial medium was because it seemed desirable to ascertain if the organisms developing on this soil were of the same kind as had previously been observed to grow on ordinary agar inoculated from the same source. Accordingly the organisms that developed in the serum cultures have been investigated morphologically, culturally, and also as regards their virulence for white mice.

The streptococci obtained from the scarlatinal tonsil, and manifesting virulence for the mouse, have been further observed in several instances by noting the effect on their characters of passage through a succession of these animals.

The cases which have been examined consist chiefly of examples of the mild uncomplicated type of scarlatina, several of them being in an early stage of the disease. A few cases suspected of being scarlatina, but in which the clinical symptoms did not justify a definite diagnosis of that condition, have also been examined. In addition to these, and for the purpose of comparison, a series of diphtheria throats have been investigated with special reference to the abundance and character of the streptococci there present along with B. diphtheriæ.

At the time when the aural discharge of scarlatina was examined previously, I was not aware of the remarkable bacillus-forming capacity of some strains of S. scarlatinæ; moreover, as a small Xerosis-like bacillus was not infrequently present in the otorrhœa cultures, it was desirable to see if this organism might not in some instances be a form of S. scarlatinæ that I had overlooked. I have, therefore, taken the opportunity of again examining the scarlatinal ear discharge, and have made a detailed study of the characters of the bacteria present in seven cases.

Finally, the comparative investigation of Streptococcus pyogenes has been continued. It will be remembered that the streptococcus obtained from the blood and organs in five cases after death from scarlatina, and described in last year's report, could not be absolutely identified with S. scarlatinæ because it was only in one or two special points that it differed from examples of S. pyogenes with which comparison had been up to that time made. It was desirable, therefore, to see if any exceptional examples of S. pyogenes occurred which did not differ from the streptococcus of the scarlatinal cadaver in these special points. An excellent opportunity for comparison occurred recently in a case of septicæmia due to a streptococcic invasion that started from the larynx, and also in two rapidly fatal cases of pneumonic plague, in both of which, besides B. pestis, a streptococcus was isolated from the spleen.

For the opportunity of examining many of the following cases of scarlatina I am indebted, as on previous occasions, to Dr. Hopwood. I am also indebted to Dr. Kearney for some of the earliest

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On the Bacteriology of Scarlatina; by Dr. Gordon.

cases. Dr. Gayton, medical superintendent of the North-Western Hospital, very kindly gave me the opportunity of examining the cases of scarlatinal otorrhœa. To Dr. McCombie, medical superintendent of the Brook Hospital, and to his assistant medical officers, Drs. Griffiths and Willcox, I have also to record my thanks for the opportunity of examining diphtheria cases. Finally, I have to thank Dr. Andrewes, who has kindly continued to supply me with streptococci from various sources.

SECTION III.

In this section I shall describe the results of further examination of the tonsillar secretion, first during an attack of scarlatina, secondly during an attack of suspected scarlatina, and thirdly during an attack of diphtheria.

(A.) Further Observation of the Secretion on the Surface of the Tonsil during an Attack of Scarlatina.

Ten cases of what was from the clinical point of view mild, but pure, scarlatina, have been investigated in the following way. A measured dilution of the tonsillar secretion of the patient was spread out over the surface of a tube of solidified blood-serum (horse's), and the tube then incubated at 37° C. The colonies that appeared in the course of forty-eight hours were examined microscopically and sub-cultured. The various micro-organisms present, having been thus isolated in pure culture, were examined with regard to their morphological, cultural, and physiological characters. As in previous stages of the inquiry, the animals on which their pathogenicity was tested were white mice. On a few occasions, when a guinea-pig was also inoculated no lesion resulted. Blood-serum, however, was not the sole medium used for the purpose of isolating micro-organisms from the tonsillar secretion. In some cases a broth culture was also made from a high dilution, and on one occasion (Case II.), where the serum culture failed to yield a pathogenic strain of S. scarlatinæ, an agar plate inoculated with a lower dilution was successful.

The results were as follow :—

Case I.—Lab. No. 62. E. W., female, age 12. Second day since the attack of scarlatina began. The rash, which has just come out, is very typical. A dilution representing approximately $\frac{1}{250000}$ cc. of the mucous secretion on the surface of the tonsil of the patient was spread out over the surface of a serum tube. After 24 hours' incubation at 37° C. the culture showed several small colonies which were of two kinds. (*a*) The more prominent were opaque, slightly raised, firmly outlined, and were found microscopically to consist of a somewhat conglomerate streptococcus. (*b*) The other colonies present were fainter, smaller, and more transparent than the preceding, but were also found microscopically to be formed by a streptococcus. Sub-cultures from colonies of each type showed that those of type (*a*) were all formed by a streptococcus resembling S. scarlatinæ in cultural

and morphological characters, while those of type (*b*) were formed by an organism indistinguishable in the same respects from S. pyogenes.

The characters of the example of S. scarlatinæ thus obtained were as follows :—

Broth 1 *day* 37° C.—The fluid either remains clear or is slightly turbid, and small granular flocculi are collected on the side and at the foot of the tube. Microscopically, diplococci and short to medium chains are seen, as a rule free but showing a slight tendency here and there to conglomeration. No coherency is manifested by the growth in broth. The shape of the individuals is often spherical, but not infrequently some of them show a slightly bacillary tendency. (Fig. 12, Plate X.)

Serum condensation fluid 1 *day* 37° C.—The growth consists of short to medium chains showing a tendency to conglomeration. The majority of the individuals are coccus-shaped in this medium, but a few spindles and bacillary forms are seen at places.

Litmus milk 38° C.—In the course of 48 hours there is a strongly acid reaction, and the milk is firmly clotted.

Serum colonies 1 *day* 37° C.—The growth is a little more profuse than on agar. The colonies when discrete are small, slightly raised, and well defined. In reflected light they appear grey, and in transmitted light brownish. Microscopically many of the individuals show an oval or bacillary tendency, but round cocci arranged in pairs and in short chains are also present. Conglomeration, though indicated here and there, is not very marked in this specimen. (Fig. 14, Plate X.)

Agar colonies 1 *day* 37° C.—The growth is scanty. The colonies are seen with the hand-glass to be small, grey, round or oval, and slightly granular. A few show nodulation. Microscopically some distinctly rod-shaped forms are seen among a majority of oval cocci. (Fig. 16, Plate X.)

Gelatine colonies 20° C.—The growth is very slow, and the colonies tend to remain some distance apart. Impression preparations made on the fourteenth day show among a majority of cocci several larger spindle and bacillary forms. (Fig. 18, Plate X.)

Pathogenicity.—A mouse inoculated with the micro-organism succumbed on the third day. The micro-organism was recovered and found to be unaltered. Further details, however, as regards this point will be found under Section V.

The characters of the example of S. pyogenes, on the other hand, were as follows :—

Broth 1 *day* 37° C.—The fluid remains quite clear, growth occurring in the form of flocculi and little round masses which collect chiefly at the foot of the tube. Microscopically, although there is at places considerable conglomeration, no coherency is manifested. The individuals are round cocci formed into chains of the medius class, that is to say intermediate between S. longus and S. brevis as regards length. (Fig. 11, Plate X.)

Serum condensation fluid 1 *day* 37° C.—The growth consists entirely of weaving chains of medium length. The individuals composing the chains are typical round, or slightly flattened cocci.

Litmus milk 1 *day* 37° C.—In the course of 48 hours the litmus shows a feebly acid reaction. The acidity increases until it is fairly well marked. After a month's incubation there is a markedly acid reaction, but no clot.

Serum colonies 1 *day* 37° C.—The growth is rather less extensive than in the case of the example of S. scarlatinæ, and, unlike that organism, is a little less copious than the growth on agar. The colonies when discrete are seen to be minute transparent plaques. Microscopically the growth is seen to consist entirely of strictly spherical cocci which are frequently arranged in pairs or in short chains. (Fig. 13, Plate X.)

Agar colonies 1 *day* 37° C.—The growth on agar is more copious than in the case of S. scarlatinæ, and the colonies are rather larger and smoother, though the latter quality varies. Microscopically the appearance is similar to that of the serum growth, the spherical shape being strictly preserved. (Fig. 15, Plate X.)

Gelatine colonies 20° C.—The growth is faster than in the case of S. scarlatinæ, and continuity of the growth along the line of inoculation is also better shown than in the case of that organism. Impression preparations made on the fourteenth day show that the colonies are entirely composed of round cocci, no spindle or bacillary forms being present. (Fig. 17, Plate X.)

Pathogenicity.—A mouse was inoculated and succumbed on the third day. The organism was recovered unaltered.

In this case, therefore, examined at a very early stage of scarlatina, *e.g.*, on the second day, a serum culture made from $\frac{1}{250000}$ cc. of the tonsillar secretion of the patient yielded colonies of only two kinds. Both were streptococci, one corresponding in morphological and cultural respects with S. scarlatinæ, the other with S. pyogenes. Each streptococcus brought about the death of a mouse in three days, and was recovered unaltered in morphological and cultural respects.

CASE II.—Lab. No. 60. F. M. Female, aged 20. Third day since attack began. The rash is typical of scarlatina. A serum culture was made with $\frac{1}{1000000}$ cc. of the tonsillar secretion, and a surface agar plate with $\frac{1}{50000}$ cc. of the same. From the serum culture two streptococci respectively similar in morphological and cultural characters to the examples of scarlatinæ and pyogenes found in the previous case were isolated. But while the mouse inoculated with the present example of S. pyogenes succumbed on the 8th day, and that organism was recovered from its organs, the mouse inoculated with the example of S. scarlatinæ showed no illness. A search was therefore made in the agar plate inoculated with the lower dilution of the tonsillar secretion, and another example of S. scarlatinæ isolated. This organism had the same morphological and cultural characters as the S. scarlatinæ from the serum culture, but was virulent. A mouse inoculated with it succumbed on the 10th day, and the organism was recovered from the animal. In the present case, as in Case I., neither the example of S. pyogenes nor that of S. scarlatinæ appeared to be altered in morphological and cultural respects by passage through a mouse.

CASE III.—Lab. No. 58. J. N. Male, aged 19. Fourth day since the attack began. As in the two previous cases, the rash is

very characteristic. A serum culture, made from $\frac{1}{50000}$ cc. of the tonsillar secretion, showed after 17 hours at 37° C. several raised, opaque, well-defined colonies, which on microscopical examination were found to be formed by a micrococcus exhibiting marked coherency and several spindle and bacillary forms (Figs. 1 and 2, Plate VII.). From these and other morphological and cultural characters, the organism was identified with S. scarlatinæ. Although many of the colonies were sub-cultured, all turned out to be the same organism. In this case, therefore, a pure culture of an organism morphologically and culturally indistinguishable from S. scarlatinæ was obtained. Six colonies of the serum culture sub-cultured into litmus milk produced a strongly acid reaction and firm clot in 48 hours in each instance. A mouse, however, which was inoculated from a 48 hours' broth sub-culture, was apparently unaffected. Therefore, although the organism isolated in pure culture from $\frac{1}{50000}$ cc. of the tonsillar secretion had the morphological and cultural characters of S. scarlatinæ strongly developed, it possessed no apparent virulence for the mouse.

CASE IV.—Lab. No. 59. C. G. Female, aged 14. Fourth day since the attack began. A serum culture inoculated with $\frac{1}{1000000}$ cc. of the tonsillar secretion of the patient showed in the course of 48 hours numerous small colonies. As the result of many sub-cultures from these three different organisms were isolated. The first was indistinguishable in morphological and cultural respects from S. scarlatinæ, the second had the morphological and cultural characters of S. scarlatinæ with one exception, namely, that in litmus milk the acid reaction was not a strong one and no clot was produced. The third organism was indistinguishable in morphological and cultural respects from S. pyogenes.

A sub-culture of each of the three types of streptococcus was injected into a mouse. The first organism, which was morphologically and culturally indistinguishable from S. scarlatinæ, produced death in three days; the second, which was similar to S. scarlatinæ, except with regard to litmus milk, produced death in four days; and the third organism, which had the morphological and cultural characters of S. pyogenes, produced death in two days. In all three cases the organisms were recovered from the tissues of the mouse post-mortem and re-examined. The first and third organisms were found to be practically unaltered, but the second organism, which resembled S. scarlatinæ except in its growth in litmus milk, was now found to have undergone considerable morphological alteration. This matter, however, will be further dealt with in Section V.

Serum was not the only culture medium on which the tonsillar secretion of this case was sown. A surface agar plate was also made from $\frac{1}{50000}$ cc. of the tonsillar secretion of the patient, and an organism having all the morphological and cultural characters of S. scarlatinæ isolated. It was injected into a mouse, which succumbed on the 10th day.

CASE V.—Lab. No. 64. M. K. Female, aged 25. Fifth day since attack began. A serum culture inoculated with $\frac{1}{300000}$ cc. of the tonsillar secretion of the patient showed after 48 hours at 37° C. about a dozen grey, round, raised colonies, some 1 mm. in diameter, others smaller. The larger colonies were found micro-

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scopically to be composed of a majority of spindles, and several bacillary forms among a minority of cocci (Fig. 3, Plate VII.). The smaller colonies, in which the individuals were also found to be smaller than in the preceding, showed a majority of coccus and oval elements, and comparatively few bacillary forms. Colonies of both types were sub-cultured in broth, litmus milk, agar and gelatine. Broth sub-cultures from the larger colonies became turbid, and microscopically the growth consisted of short to medium chains, the individuals of which were coccus-shaped entirely, thus affording considerable contrast to the growth on serum. Litmus milk showed a fair acid reaction, but no clot. The growth on agar and also on gelatine was indistinguishable from that of S. scarlatinæ. Sub-cultures from the smaller colonies were like those from the larger colonies, except that they produced a strongly acid reaction and firm clot in litmus milk in two days. A mouse injected with a sub-culture from one of the larger colonies was unaffected.

Summary.—A serum culture inoculated with $\frac{1}{300000}$ cc. of the tonsillar secretion showed two kinds of organism. Both of them resembled S. scarlatinæ in growth on solid media, but while one clotted milk with a strong acid reaction the other produced only a fair acid reaction and no clot. The latter organism developed spindle-shaped forms very well on serum. It was not pathogenic to a mouse.

CASE VI.—Lab. No. 70. H. A. Female, aged 22. Fifth day of the illness. The scarlatinal rash is very typical in the present case. Two serum tubes were inoculated, one with $\frac{1}{100000}$ cc. and the other with $\frac{1}{500000}$ cc. of the tonsillar mucus. Both tubes gave in 48 hours what appeared to be a pure culture of S. scarlatinæ. The procedure in the present case was somewhat different to that used in other cases. The *whole* of the growth in the tube that had been inoculated with $\frac{1}{100000}$ cc. of the tonsillar secretion was now scraped off, distributed in 1 cc. of broth and half of it injected into a guinea-pig, the other half into a mouse. The guinea-pig was unaffected, but the mouse succumbed on the fifth day. Post-mortem examination of the mouse showed a collection of pus at the site of inoculation, congested organs, and an enlarged spleen. Cover-glass preparations made from the heart's blood, spleen, kidney, and liver revealed no organisms of any kind. The pus at the site of inoculation, however, was crowded with the coccus, arranged chiefly in pairs and in short chains, and showing a tendency to conglomeration. Agar cultures were made from the heart's blood, kidney, liver, and spleen; and from a dilution of the pus at the site of inoculation an agar plate and a serum culture were made, No growth whatever occurred except from the pus at the site of inoculation, which gave, both on serum and on agar, a pure culture of the organism injected. In morphological and cultural characters this example of S. scarlatinæ was found to be unaltered.

The growth in 48 hours on the serum tube inoculated from the dilution of the pus of the mouse, and which appeared to be a pure culture of S. scarlatinæ, was scraped off, distributed in 1 cc. of broth, and injected into a guinea-pig, which died on the seventh day. The result of its post-mortem examination will be given later.

Summary.—A serum culture inoculated with $\frac{1}{100000}$ cc. of the tonsillar secretion of a patient on the 5th day of scarlatina therefore gave in 48 hours what appeared to be a pure culture of S. scarlatinæ. The total growth was divided into two parts and a guinea-pig injected with one, a mouse with the other. The guinea-pig was unaffected, but the mouse died on the 5th day and S. scarlatinæ was recovered from it. A second guinea-pig inoculated with the S. scarlatinæ recovered from the mouse died on the 7th day.

CASE VII.—Lab. No. 65. I. G. Female, aged 4. Sixth day since the attack began. A serum culture inoculated with $\frac{1}{300000}$ cc. of the tonsillar secretion of the patient showed in 48 hours a good crop of colonies. The most prominent of these were round, opaque, and raised. Microscopically they were found to consist almost entirely of spindle and bacillary-shaped forms (Fig. 8, Plate IX.). The bacillus-formation in fact was so marked and their shape and arrangement so suggestive of B. diphtheriæ that the question arose whether it was not an example of that organism. A subculture, in broth, however, showed that the organism was in reality a streptococcus (Fig. 10, Plate IX.). In other morphological and cultural respects the organism resembled S. scarlatinæ.

There was, however, another type of colony present in the serum culture made from $\frac{1}{300000}$ cc. of the tonsillar secretion. The second type of colony was rather smaller than the first, less raised, and showed distinct nodulation. Microscopically the majority of the individuals were cocci, but here and there a few swollen and slightly bacillary forms were seen. The size was smaller than in the first kind of colony. Sub-cultures on various media showed that in other respects the organism resembled S. scarlatinæ.

A mouse injected with a sub-culture from the first type of colony was unaffected.

CASE VIII.—Lab. No. 66. F. W. Male, aged 12. Sixth day since the attack began. A serum culture made with $\frac{1}{100000}$ cc. of the tonsillar secretion of the patient showed in the course of 48 hours three colonies. Microscopically the colonies were found to be composed of a majority of spindle and bacillary forms, and a minority of cocci. Conglomoration was also very well shown. In other morphological and cultural respects the organism present corresponded with S. scarlatinæ. A mouse injected with it showed on the 10th day local suppuration, which afterwards healed up.

A broth culture inoculated with $\frac{1}{150000}$ cc. of the tonsillar secretion of this case showed a copious growth of streptococci that in appearance resembled S. scarlatinæ in broth.

CASE IX.—Lab. No. 68. R. R. Male, aged 14. Has had two attacks of scarlatina. It is now 39 days since the onset of the first, and 25 days since the second began. The patient is convalescent. A serum culture made with $\frac{1}{100000}$ cc. of the tonsillar secretion showed in 48 hours several colonies. Subcultures from these gave only one kind of organism, which in morphological and cultural respects resembled S. scarlatinæ. A mouse inoculated with it, however, was unaffected.

From the same case a broth culture was inoculated with $\frac{1}{250000}$ cc. of the tonsillar secretion. In 48 hours the growth was found to be entirely composed of streptococci, and many of these resembled S. scarlatinæ when growing in broth.

CASE X.—Lab. No. 69. T. K. Male, aged 17. Thirty-fourth day since onset of the attack. The patient has had adenitis as a complication. From a serum culture inoculated with $\frac{1}{100000}$ cc. of the tonsillar secretion two organisms were isolated. Both corresponded in general morphological and cultural respects with S. scarlatinæ, but while the first produced a strongly acid reaction and a firm clot in litmus milk, the second only produced a fairly acid reaction, and no clot. A mouse injected with the first organism was found dead on the 16th day, but as putrefaction had begun it was not attempted to recover the organism.

From $\frac{1}{250000}$ cc. of the tonsillar secretion of the same case a broth culture was made. The growth consisted entirely of streptococci, which in appearance resembled S. scarlatinæ when growing in broth.

ANALYSIS SHOWING RESULT OF QUANTITATIVE EXAMINATION OF THE TONSILLAR SECRETION DURING SCARLATINA.

Case.	Stage of Scarlatina.	Approximate amount of Tonsillar Secretion used.	Medium inoculated.	Organism with Morph. and Cult. Characters of S. Scarlatinæ.	Effect of same on a Mouse.	Organism with Morph. and Cult. Characters of S. Pyogenes.	Effect of same on a Mouse.
I.	2nd day	$\frac{1}{250000}$ cc.	Serum	+	Dead 3rd day	+	Dead 3rd day
II.	3rd day	$\frac{1}{50000}$ cc.	Agar..	+	Dead 10th day		
		$\frac{1}{100000}$ cc.	Serum	+	Unaffected ..	+	Dead 8th day
III.	4th day	$\frac{1}{50000}$ cc.	Serum	+	Unaffected ..	–	
IV.	4th day	$\frac{1}{50000}$ cc.	Agar..	+	Dead 10th day		
		$\frac{1}{100000}$ cc.	Serum	+ +	Dead 3rd and 4th day respectively.	–	Dead 2nd day
V.	5th day	$\frac{1}{500000}$ cc.	Serum	+	Unaffected ..	–	
VI.	5th day	$\frac{1}{50000}$ cc.	Serum	+		–	
		$\frac{1}{100000}$ cc.	Serum	+	Dead 5th day.	–	
VII.	6th day	$\frac{1}{500000}$ cc.	Serum	+	Unaffected ..	–	
VIII.	6th day	$\frac{1}{100000}$ cc.	Serum	+	Local suppuration 10th day. Recovery.	–	
IX.	18th day	$\frac{1}{100000}$ cc.	Serum	+	Unaffected ..	–	
X.	34th day	$\frac{1}{100000}$ cc.	Serum	+	Dead 16th day, org. not recovered.	–	

SUMMARY.

1. Organisms having the morphological and cultural characters of Streptococcus scarlatinæ were isolated from the secretion on the surface of the tonsil in all 10 cases of scarlatina examined.

2. In six cases the specimen of S. scarlatinæ isolated from the tonsillar secretion proved virulent for a mouse, but in four cases the mouse was, apparently, unaffected.

3. In seven cases S. scarlatinæ was the only organism present in the serum cultures made from dilutions varying from $\frac{1}{5000}$ cc. to $\frac{1}{300000}$ cc. of the tonsillar secretion.

4. In three cases an organism having the morphological and cultural characters of Streptococcus pyogenes was present together with S. scarlatinæ in the serum culture made from a high dilution of the tonsillar secretion.

5. In all three cases the specimen of S. pyogenes proved fatal to a mouse.

6. The three cases in which S. pyogenes was present were the earliest examined; the stage being the second, third, and fourth day of the disease, respectively.

7. The presence of S. pyogenes in the serum cultures from the tonsillar secretion in so early a stage of the disease, and the fact that it was so abundant there, point to its bearing an important rôle in the early stage of scarlatina.

8. Conversely, its absence in the serum cultures from the tonsillar secretion in the other seven cases makes it equally impossible to attribute to S. pyogenes anything but a subsidiary *rôle* in the causation of the strictly scarlatinal process.

(B.) THE TONSILLAR SECRETION IN CASES OF SUSPECTED SCARLATINA.

The following three cases, which occurred during an outbreak of scarlatina in a public school, were regarded with suspicion, because the persons had been associated with others who developed at the same time typical scarlatina. In those three cases, however, the diagnosis of scarlatina, on clinical grounds, was not justified at the time of making the bacteriological examination. I am indebted to N. H. Joy, Esq., M.R.C.S., for particulars of the cases, and for the opportunity of examining them.

CASE I.—S. G. Schoolboy, aged 11, has been as much exposed to infection as his brother who has developed scarlatina. He has never complained of sore throat, nor of any malaise. For the last three days his throat has been slightly reddened, the congestion spreading on to the palate. The temperature has been taken night and morning for the last five days, and has been found to be very

slightly above normal, but never higher than 99·8° F. He is a very excitable child, and Mr. Joy believes that the slight rise of temperature may be due to this cause. The cervical glands are not enlarged, and no rash has been observed.

A surface agar plate made from a dilution of the swab from the patient's throat showed several colonies of Staphylococcus aureus, and a majority of streptococcus colonies. Two types of streptococcus were isolated, one of them of the medius class as regards its growth in broth, while the other showed shorter chains and a tendency to conglomeration in the same medium. Both streptococci clotted milk with a strongly acid reaction in two days. The streptococcus showing a tendency to conglomeration was injected into a mouse, which was unaffected.

I failed, therefore, to isolate a streptococcus identifiable with S. scarlatinæ from this case. Mr. Joy informed me later that no desquamation occurred.

Case II.—A. C. Housemaid, 18, does not know if she has previously had scarlatina, but has been in contact with it before without becoming infected. For the last five days she has been suffering from an affection that does not differ from an ordinary attack of follicular tonsillitis. The course of the disease has been characteristic of follicular tonsillitis, and she is practically well now, but the fauces are still congested. The cervical glands are not enlarged, and there are no signs of a rash.

A surface agar plate made from a dilution of the swab from this case showed no staphylococcus colonies, but many streptococcus colonies. Several of the latter were subcultured, and all appeared to be of the same kind. This streptococcus made broth turbid, and microscopically chains of medium length were found. Milk was clotted with a strongly acid reaction in three days. A mouse injected with the streptococcus was, apparently, unaffected.

No Streptococcus scarlatinæ, therefore, was isolated from this case. Mr. Joy informed me later that no desquamation had been observed.

Case III.—W. V. Schoolboy, aged 15, had a severe attack of scarlatina three years ago. He had a sore throat and a rise of temperature a week ago, and was in consequence isolated. No rash has appeared. The cervical glands are enlarged. The temperature has been raised for a week, but he is now, on the eighth day, much better; the only symptons lingering being slight congestion of the fauces, and some enlargement of the cervical glands.

A surface agar plate, made from a dilution of the swab from the patient's throat, showed, besides Staphylococcus albus, a majority of streptococcus colonies. Two types of the latter were subcultured. In the first, the original colony on the agar plate was nodulated. Broth was made turbid by the streptococcus, and conglomeration was found microscopically. Litmus milk showed a strongly acid reaction, and was firmly clotted in two days. A mouse injected with the streptococcus showed no symptoms till

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the ninth day, when local suppuration began at the site of inoculation. After spreading for a little this healed up, and the mouse recovered.

The second type of streptococcus present had the following characters. The original colony on the agar plate was smooth, with a slightly ragged edge, but no nodulation. In the broth subculture the fluid was left clear and the growth occurred as small flocculi, which tended to collect together at the foot of the tube into little balls. The growth was easily spread over a cover-slip, and microscopically the appearance was that of streptococcus pyogenes, the chains being of medium length and showing at places a considerable tendency to conglomeration. Litmus milk showed a fairly acid reaction, but no clot even in a month. The growth of this streptococcus, both on agar and on gelatine, was more profuse than that of the first. A mouse injected with it died in three days and the streptococcus was recovered from its blood and organs in pure culture.

In this case, therefore, where, although no rash was observed, the clinical symptoms were more suggestive of scarlatina than in the two previous cases, two kinds of virulent streptococcus were isolated from the throat. The first resembled S. scarlatinæ in the morphological and cultural characters observed, the second S. pyogenes. The former produced a local reaction in the mouse on the ninth day, the latter a fatal result on the third day. The bacteriological results therefore tended to confirm the suspicion that this was a case of scarlatina, a suspicion that received in turn subsequent clinical confirmation in Mr. Joy's observation of some desquamation between the toes and at the tips of the fingers.

There was another point about this outbreak of scarlatina that had been engaging attention, and that was its source. Although scarlatina had been for some time in the neighbourhood, no cases had been observed in the immediate vicinity of the school. Some communication had of necessity occurred between the infected localities and the particular village in which the school was situated. It was possible, therefore, that from the village one of the schoolboys had carried the infection either directly or indirectly to his schoolfellows, and so started the outbreak. There was, however, another possible vehicle of the infection, namely, the milk. Mr. Joy was at some pains to investigate this source, but there were several points that tended to exclude the milk as the vehicle of the virus. Chief among them was the fact that, although the boys who developed scarlatina had all partaken of milk from the same source, their schoolfellows who had also taken the milk escaped. There was no reason to suspect the cows at the farm of suffering from any disease. Mr. Joy therefore inquired into the personal health of the people concerned in the milk supply, and he found that among them was a girl who had been suffering from a sore throat for some time. Although she had been ill in this way for some weeks there was no history of a rash. The girl, however, now showed some desquamation, and at places she showed "pin point peeling."

A swab from the throat of this case was sent me by Mr. Joy and from it I made a surface agar plate. From the latter I isolated

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a streptococcus that had the morphological and cultural characters of S. scarlatinæ, and when injected into a mouse brought about its death on the eighth day. In virulence, therefore, this streptococcus also corresponded with S. scarlatinæ.

Accordingly the bacteriological evidence obtained in this case, as in the other, was of a confirmatory nature to the clinical. But for the reasons stated above it cannot be said that the origin of the outbreak is also made clear at the same time, although the facts elicited go some little way to affording a possible explanation.

Analysis of Cases of suspected "School" Scarlatina.

	Case.	I.	II.	III.	IV.
Clinical.	Occupation.	Schoolboy.	Housemaid.	Schoolboy.	Girl at milk supply.
	Past history *re* Scarlatina.	Not hitherto infected.	Though previously exposed, not infected.	Severe scarlatina 3 years ago.	Not known to have been infected.
	Present illness. Fever	Very slight for 2 days.	Slight.	Fever for a week.	None observed.
	Present illness. Rash	None.	None.	None.	None observed.
	Present illness. Throat	Slightly reddened.	Follicular tonsillitis.	Sore throat.	Persistent sore throat.
	Present illness. Cerv. glands.	Not enlarged	Not enlarged.	Enlarged.	Not enlarged.
	Desquamation	None.	None.	Desquamated between toes and at tips of fingers.	Pin-point peeling at places, flaky desquamation of palms of hands.
	Clinical diagnosis.	Slight sore throat.	Follicular tonsillitis.	?Scarlatina without rash.	?Scarlatina without rash.
Bacteriological.	Bacilli	None.	None.	None.	None.
	Staphylococci	Aureus.	None.	Albus.	Aureus. Albus.
	Streptococci ..	Many. The one most resembling S. scarl. was injected into a mouse with no result.	Many. Only one resembling S scarl. was found. A mouse injected with it was unaffected.	Many. One resembling S. pyogenes killed a mouse in 3 days. Another resembling S. scarl. produced in 10 days local suppuration, from which mouse recovered.	Many. One resembling S. scarl. killed a mouse on the 8th day. The organism was recovered from local lymph gland and from blood and organs.
	Result *quâ* S. scarlatinæ,	Negative.	Negative.	Positive.	Positive.

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(C.) THE SECRETION ON THE SURFACE OF THE TONSIL DURING AN ATTACK OF DIPHTHERIA.

In order that the results obtained by the study of the bacteriology of the tonsillar secretion during scarlatina may be correctly interpreted, it is highly desirable to have some information concerning the micro-organisms to be met with in the same situation in other conditions. Some comparative observations on the bacteriology of the tonsillar secretion, both normally and also in inflamed but non-scarlatinal states, were included in my last report. During the past year these observations have been continued, special attention having been paid to the tonsillar secretion during an attack of diphtheria.

The same procedure has been practised in these further control-observations as in the further examination of the scarlatinal throat. By means of a high but approximately known dilution, it has been possible to inoculate media with a very small quantity of the tonsillar secretion. Serum has been the chief initial culture medium used, but in some cases broth cultures were also made. The advantage of the dilution method in restricting attention to the organisms most numerously present is considerable, for in this way prominence is given to the important subject of relative abundance.

In the secretion on the surface of the normal tonsil, and in normal saliva, I have found that streptococci are abundant, and may even exceed 100,000 per cc. Those streptococci obtainable from the tonsillar secretion of apparently healthy individuals are also various; while the familiar types of longus, medius, and brevis are all to be met with, intermediate forms occur that cannot be definitely included in any of these classes. A point of some importance is that Gram's stain is held by almost all of them. Some of the streptococci present in the normal throat may show marked coherency and conglomeration, rivalling even S. scarlatinæ in this respect. The clotting of litmus milk with a strongly acid reaction is also sometimes effected, and bacillus-formation is by no means infrequently exhibited. Some of them also show nodulation of their colonies. But whenever tested on a mouse these streptococci of the normal mouth and throat have not as yet been found to exhibit any pathogenicity whatsoever.*

Streptococci, therefore, of various kinds, some approaching S. scarlatinæ in one or more ways, but without pathogenicity for the mouse, have been found to occur in the tonsillar secretion without apparently interfering with the health of their host. So common indeed is streptococcus in normal saliva that I believe that this class of organism is characteristic of the mouth and pharynx, somewhat after the manner that B. coli is characteristic of the lower portion of the alimentary tract. It must not, however, be supposed that the abundance of streptococci in the normal tonsillar secretion discounts the significance of the presence of a pathogenic organism of this group in scarlatina any more than the significance of the typhoid bacillus in typhoid fever is impaired by the fact that it belongs to the same group as B. coli of the normal intestine.

* The only exception to this statement is Diplococcus Pneumoniæ which is occasionally met with in cultures from the normal throat and resembles S. brevis in broth.

It remains nevertheless a matter of some importance to ascertain the behaviour of these indigenous streptococci when B. diphtheriæ in an actively pathogenic state is multiplying in the throat. The problem, however, is one of no little complexity, and requires prolonged and detailed study before any very definite conclusions can be drawn. The following observations only touch the fringe of a subject that, apart altogether from the point of view of the bacteriology of scarlatina, is of no little importance for the truer understanding not only of diphtheria, but also of other diseases of the mouth, pharynx, or respiratory passages in which pathogenic micro-organisms, whether already identified or not, are concerned :—

CASE I.—E. C. Female, aged five. Fourth day since the attack of diphtheria, which is a severe one, began. The following cultures were made from the tonsillar secretion :—

With $\frac{1}{150000}$ cc. a serum culture.
" $\frac{1}{150000}$ cc. a broth culture.
" $\frac{1}{1000000}$ cc. a serum culture.
" $\frac{1}{1000000}$ cc. a broth culture.

The serum inoculated with $\frac{1}{150000}$ cc. showed, after 17 hours at 37° C., numerous grey raised colonies of a bacillus morphologically indistinguishable from B. diphtheriæ, and giving a positive result with Neisser's stain. Some smaller colonies, also present, turned out to be streptococci, and streptococcus chains were also found in the condensation fluid at the foot of the tube. The broth inoculated with $\frac{1}{150000}$ cc. of the tonsillar secretion showed turbidity and flocculi. Microscopically cocci alone, seemingly all streptococci, were present. The serum tube inoculated with $\frac{1}{1000000}$ cc. of the tonsillar secretion showed in 48 hours no growth on the surface, but in the condensation fluid a streptococcus was present in pure culture. The broth inoculated with $\frac{1}{1000000}$ cc. of the tonsillar secretion remained clear, and at the foot of the tube was a flocculus that was found, on microscopical examination, to be a long streptococcus showing at places considerable tendency to conglomeration. An agar plate sub-culture showed that the streptococcus was present in the broth in pure culture.

Particulars of the Organisms Isolated.—The bacillus present in the serum tube inoculated with $\frac{1}{150000}$ cc. of tonsillar secretion, and having the morphological appearance of B. diphtheriæ, was sub-cultured in various media, and found to also have the cultural characters of that organism. In litmus milk at 37° C. an acid reaction was slowly produced, but no clot. A guinea-pig, inoculated with 1 cc. of a 48 hours' broth sub-culture, died in 48 hours, and showed, post-mortem, the lesions usually produced by B. diphtheriæ. Serum-cultures were made from the site of inoculation, spleen, kidney, liver, and heart's blood. In the case of the former locality alone was the organism recovered, the other cultures remaining sterile. The bacillus was thus identical with B. diphtheriæ in morphological, staining, cultural, and pathogenic respects.

From the same serum culture inoculated with $\frac{1}{150000}$ cc. of the tonsillar secretion a streptococcus was also isolated. Its characters were as follows :—

Broth one day, 37° C.—The fluid is slightly turbid, and a deposit is collected at the side and foot of the tube. Microscopically the organism present is found to be a streptococcus showing a marked tendency to conglomeration.

Litmus Milk, 37° C.—In one day a strong acid reaction is produced, and in two the milk is firmly clotted.

Agar one day, 37° C.—The growth is less copious than in the case of S. pyogenes. The colonies are small, oval or irregular, and slightly granular. Microscopically it is found to be composed of minute cocci often arranged in chains, and showing some tendency to conglomeration.

Gelatine, 20° C.—The growth is slower than that of Streptococcus pyogenes.

Pathogenicity.—A mouse and a guinea-pig were both injected with a 48 hours broth sub-culture of the streptococcus. Neither was affected.

The streptococcus present in pure culture in the serum tube inoculated with $\frac{1}{1000000}$ cc. of the tonsillar secretion was identical in morphological and cultural

respects with that present in the broth inoculated with the same amount. The streptococcus had the following characters :—

Broth one day 37° C.—The fluid remains clear, growth occurring in the form of a conglomerate flocculus at the foot of the tube. Microscopically coherency is so marked as to rival even the most coherent type of S. scarlatinæ in this respect.

Litmus Milk 37° C.—In two days there is a slight acid reaction. In a week the acidity has increased. In a month there is still no clot.

Agar one day 37° C.—There is a fair growth of round or oval, grey, slightly granular colonies. The growth is a little less extensive than in the case of S. pyogenes. Microscopically conglomeration is seen. The individuals are for the most part minute cocci. A few spindle-shaped forms were seen, but no bacillary forms.

Pathogenicity.—A mouse inoculated with a 48 hours' broth sub-culture of the streptococcus isolated from the serum culture was unaffected.

Summary.—The secretion on the surface of the tonsil of this case of severe diphtheria contained on the fourth day of the disease, at least 250,000, but under a million diphtheria bacilli per cc., and at least one million streptococci per cc. But while the diphtheria bacillus isolated from $\frac{1}{250000}$ cc. of the tonsillar secretion produced death in a guinea-pig in 48 hours, neither the streptococcus isolated from the same culture, nor that isolated from $\frac{1}{1000000}$ cc. of the tonsillar secretion, was pathogenic to a mouse. Both the streptococci, however, resembled S. scarlatinæ in one or more morphological and cultural respects. Therefore, although these streptococci were more abundant than bacillus diphtheriæ in the tonsillar secretion, they did not appear to have any pathogenic significance.

Owing to the fact that in some other cases of diphtheria examined at the same time the cultures made from dilutions similar to those used in this case gave either no growth at all, or only a few streptococci, it was decided to make the primary cultures in future from a lower dilution of the tonsillar secretion. In the remaining cases of diphtheria, therefore, no serum cultures were made from less amounts of tonsillar secretion than approximately $\frac{1}{100000}$ cc.

CASE II.—E. D. Female, aged 8. Fourth day since the attack of diphtheria began. From the tonsillar secretion the following cultures were made :—

With $\frac{1}{50000}$ cc. a serum culture.
" $\frac{1}{100000}$ cc. do.
" $\frac{1}{100000}$ cc. a broth culture.
" $\frac{1}{150000}$ cc. do.

The following results were obtained :—The serum culture inoculated with $\frac{1}{50000}$ cc. of tonsillar secretion showed in 17 hours numerous colonies of a bacillus morphologically resembling B. diphtheriæ, and also some smaller colonies of streptococci. The serum culture made from $\frac{1}{100000}$ cc. also showed the diphtheria-like bacillus together with streptococci. The two broth cultures, inoculated respectively with $\frac{1}{100000}$ cc. and $\frac{1}{150000}$ cc. of tonsillar secretion, both showed turbidity and flocculi. Microscopical examination showed that in each case the growth in the broth consisted entirely of cocci, of which the great majority appeared to be streptococci. No diphtheria bacilli were seen in the broths

Particulars of the Organisms Isolated.—A sub-culture of the bacillus morphologically resembling B. diphtheriæ was made from a colony of it in the serum tube that had been inoculated with $\frac{1}{100000}$ cc. of tonsillar secretion. When grown in litmus milk the bacillus produced a feeble acid reaction, but no clot: and in other cultural respects it also resembled B. diphtheriæ. A guinea-pig injected with 1 cc. of a 48 hours' broth sub-culture was dead in 48 hours with the appearances usually produced by B. diphtheriæ. The bacillus was recovered from the site of inoculation, but, as in Case I., not from elsewhere. In morphological, cultural, and pathogenic respects, therefore, this bacillus was identical with B. diphtheriæ.

From the serum culture inoculated with $\frac{1}{100000}$ cc. of tonsillar secretion a streptococcus was also isolated. Its characters were as follows :—

Broth one day 37° C.—Turbidity is produced, and there is a conglomerate precipitate of growth at the foot of the tube. Microscopically the growth was

found to consist of a streptococcus rivalling S. scarlatinæ in coherency and conglomeration.

Agar condensation fluid 2 *days* 37° C.—Conglomeration is well marked. The chains, which are well seen at places, are of medium length. Bacillary forms are present among a majority of coccus-shaped individuals.

Serum condensation fluid 1 *day* 37° C. Chain formation is better developed than in the two previous media. Conglomeration is indicated at places. The individuals are mostly coccus-shaped, but a few are slightly bacillary.

Litmus milk 37° C.—By the second day there is a strong acid reaction and the milk is firmly clotted.

Agar colonies 1 *day* 37° C.—The growth is less profuse than in the case of Streptococcus pyogenes. The colonies are grey, slightly granular, and rather irregular in shape. At their edges chain-work is seen in some instances. Microscopically conglomeration is well shown, and among a majority of cocci are some bacillary forms.

Serum growth 1 *day* 37° C.—The growth is slight, in fact it is not more profuse than on agar. Microscopically several spindle-shaped forms and a few bacillary ones are seen among a majority of cocci.

Gelatine growth 20° C.—The growth is slower than that of Streptococcus pyogenes, and macroscopically resembles S. scarlatinæ. Impression preparations made on the seventh day show that the great majority of the individuals are coccus-shaped, but that a few oval-shaped individuals are also present. No definite spindle or bacillary forms were observed.

Pathogenicity.—A mouse injected with this streptococcus was dead in 48 hours. Post-mortem there was sub-cutaneous exudation at the site of inoculation, congested organs and an enlarged spleen. The streptococcus was recovered from the subcutaneous exudation, but not from elsewhere. The morphological and cultural characters were found to be the same as before except in two respects. While the growth in broth is as coherent as before, the fluid is now left quite clear, and secondly, the agar colonies now show no bacillary forms, but consist entirely of cocci.

Summary.—The tonsillar secretion in this case, on the fourth day of the attack of diphtheria, contained at least 100,000 virulent diphtheria bacilli per cc. There were also at least 250,000 streptococci per cc. present in the tonsillar secretion, and amongst them was a virulent streptococcus having some of the most prominent morphological and cultural characters of one type of S. scarlatinæ, and present to the extent of at least 100,000 per cc.

CASE III.—A. R. Female, aged 3. Sixth day since the attack of diphtheria began. The following cultures were made from the tonsillar secretion :—

With $\frac{1}{500000}$ cc. a serum culture.
" $\frac{1}{1000000}$ cc. do.
" $\frac{1}{1000000}$ cc. a broth culture.
" $\frac{1}{2500000}$ cc. do.

The results were as follows :—Both serum cultures showed a majority of colonies of a bacillus morphologically resembling B. diphtheriæ, and in the minority several smaller colonies of streptococci. Both broth cultures showed turbidity and granular flocculi ; and microscopical examination showed that in each case the growth consisted entirely of streptococci, which had for the most part a distinct tendency to conglomeration. No diphtheria bacilli were observed in the broth cultures.

Particulars of the Organisms Isolated.—A sub-culture of the bacillus bearing a morphological resemblance to bacillus diphtheriæ was made from a colony of it in the serum tube inoculated with $\frac{1}{1000000}$ cc. of tonsillar secretion. It was found that in cultural respects the bacillus also resembled B. diphtheriæ. A guinea-pig inoculated with 1 cc. of a 48 hours' broth sub-culture succumbed in 48 hours with the appearances usually produced by B. diphtheriæ. The bacillus was recovered from the site of inoculation. The bacillus therefore resembled B. diphtheriæ in pathogenic as well as in morphological and cultural respects.

A streptococcus, also isolated from the serum tube that had been inoculated with $\frac{1}{100000}$ cc. of tonsillar secretion, had the following characters :—

Broth 1 *day* 37° C.—The fluid is turbid, and conglomerate flocculi are collected at the foot of the tube. Microscopically a streptococcus exhibiting marked conglomeration was found to be present.

Agar condensation fluid 2 *days* 37° C.—Both conglomeration and chain-work are seen. The majority of the individuals are coccus-shaped, but a few spindles and bacillary forms are also present.

Serum condensation fluid 1 *day* 37° C.—Chains are better developed than in previous media. Conglomeration is also shown. While the majority are coccus-shaped a few spindles and bacillary forms are present.

Litmus milk 37° C.—There is a strong acid reaction in 48 hours, and the milk is firmly clotted.

Agar colonies 1 *day* 37° C.—The growth is rather more profuse than that of S. scarlatinæ, but it is less extensive than that of S. pyogenes. Microscopically conglomeration is well marked. The majority of the individuals are coccus-shaped, but a few spindles and bacillary forms are found on searching.

Serum growth 1 *day* 37° C.—The growth is less extensive than on agar. Coherency of the growth is marked. The majority of the individuals are coccus-shaped, but a few spindles and slightly bacillary forms are present.

Gelatine colonies 20° C.—The growth is slow and macroscopically resembles that of S. scarlatinæ. Impression preparations made on the seventh day show that the growth is entirely composed of cocci, no spindles or bacillary forms being seen.

Pathogenicity.—A mouse injected with the streptococcus was dead in two days, showing congested organs and an enlarged spleen.

Summary.—In this case, therefore, on the sixth day of the attack of diphtheria there were at least 100,000 virulent diphtheria bacilli per cc. of the tonsillar secretion. There were also at least 250,000 streptococci per cc. in the tonsillar secretion. One of them, present to the extent of at least 100,000 per cc., had some of the morphological and cultural characters of S. scarlatinæ, and a mouse inoculated with it was dead in 48 hours.

Case IV.—M. B. Female, aged 2. Eight days since the attack of diphtheria began. The following cultures were made from the tonsillar secretion :—

With $\frac{1}{50000}$ cc. a serum culture.
" $\frac{1}{100000}$ cc. do.
" $\frac{1}{100000}$ cc. a broth culture.
" $\frac{1}{150000}$ cc. do.

The results were as follows :—In both serum cultures the more prominent colonies were those of a bacillus morphologically resembling B. diphtheriæ, while in the minority were some smaller colonies of streptococci. Both broth cultures made from the tonsillar secretion gave a pure culture of the same streptococcus.

Particulars of the Organisms Isolated.—A single colony of the diphtheria-like bacillus in the serum tube that had been inoculated with $\frac{1}{100000}$ cc. of tonsillar secretion was sub-cultured and found to also resemble B. diphtheriæ in cultural respects. A guinea-pig inoculated with 1 cc. of a 48 hours' broth sub-culture succumbed in 36 hours. The appearances were similar to those seen in previous cases, and the organism was recovered from the site of inoculation. The bacillus therefore resembled B. diphtheriæ in pathogenicity as well as in morphological and cultural respects.

The streptococcus which appeared to be in pure culture in both the broths inoculated with the tonsillar secretion had the following characters :—

Broth 1 *day* 37° C.—The fluid remains clear and growth occurs in the form of flakes and flocculi which collect at the foot of the tube. Microscopically conglomeration is conspicuous at places, and the chains are of medium length. The growth has a strong resemblance to that of S. pyogenes, except that here the individuals show considerable irregularity as regards size, and a few spindle and bacillary forms are also detected at places.

Agar condensation fluid 2 *days* 37° C.—Chains of medium length showing a slight tendency to conglomeration at places. The majority of the individuals are coccus-shaped, but a few spindles are seen in places.

Serum condensation fluid 1 *day* 37° C.—The growth consists entirely of chains of medium length composed of spherical or slightly flattened cocci. The microscopical appearance in fact is identical with that of S. pyogenes in the same medium.

Litmus milk 37° C.—A fair acid reaction is produced, but no clot.

Agar colonies 1 *day* 37° C.—Macroscopically the growth is a good deal more profuse than that of S. scarlatinæ, and resembles that of S. pyogenes. Impression preparations show among a majority of cocci, a few bacillary forms.

Serum growth 1 *day* 37° C.—There is very fair growth. Microscopically the appearance is indistinguishable from that of S. pyogenes. No bacillary forms were seen.

Gelatine colonies 20° C.—Both macroscopically and microscopically the growth is indistinguishable from that of S. pyogenes, Impression preparations on the ninth day show that the individuals are entirely coccus-shaped.

Pathogenicity.—The specimen of this streptococcus, isolated from the broth that had been inoculated with $\frac{1}{100000}$ cc. of tonsillar secretion, was injected into a mouse. The mouse succumbed in 48 hours, and from its heart's blood the streptococcus was recovered in pure culture, and re-examined in morphological and cultural respects. It was found to be unaltered.

Summary.—The tonsillar secretion of this case on the eighth day of diphtheria therefore contained at least 100,000 virulent diphtheria bacilli per cc., and at least 250,000 streptococci in the same amount. The streptococcus present in pure culture in a broth culture made from $\frac{1}{150000}$ cc. of the tonsillar secretion was apparently identical with that present, also in seemingly pure culture, in a broth inoculated with $\frac{1}{100000}$ cc. of it. This streptococcus resembled Streptococcus pyogenes in morphological and cultural respects, and killed a mouse in 48 hours.

Case V.—W. S. Male, aged 5. Eighth day since the attack of diphtheria began. The following cultures were made from the tonsillar secretion :—

With $\frac{1}{50000}$ cc. a serum culture.
" $\frac{1}{100000}$ cc. do.
" $\frac{1}{100000}$ cc. a broth culture.
" $\frac{1}{150000}$ cc. do.

The following results were obtained. In both serum cultures the more prominent colonies were those of a bacillus morphologically resembling B. diphtheriæ ; a few smaller colonies of streptococci, however, were also present. The broth culture inoculated with $\frac{1}{100000}$ cc. of the tonsillar secretion became turbid, and flocculi were collected at the foot. Microscopically the only organisms present were streptococci. The broth inoculated with $\frac{1}{150000}$ cc. of the tonsillar secretion remained clear, and at the foot was a conglomerate mass of growth. Microscopically this was a very coherent streptococcus.

Particulars of the Organisms Isolated.—A colony of the diphtheria-like bacillus present in the serum tube, inoculated with $\frac{1}{100000}$ cc. of the tonsillar secretion, was sub-cultured, and the organism was also found to resemble B. diphtheriæ in cultural respects. A guinea-pig, injected with 1 cc. of a 48 hours, broth sub-culture, was dead in 17 hours, showing the appearances usually produced by B. diphtheriæ ; and the organism was recovered from the site of inoculation. In pathogenicity, therefore, the bacillus also resembled B. diphtheriæ.

From the serum tube inoculated with $\frac{1}{100000}$ cc. of the tonsillar secretion, a streptococcus was also isolated that was identical in morphological and cultural respects with the streptococcus present in pure culture in the broth inoculated with $\frac{1}{150000}$ cc. of tonsillar secretion. In broth, the growth of this streptococcus was indistinguishable from the most coherent type of S. scarlatinæ or conglomeratus ; litmus milk was clotted with a strongly acid reaction in 48 hours. The growth was very conglomerate on agar, and several of the individuals showed a slightly bacillary tendency. The growth on gelatine was very slow. A mouse injected from a 48 hours' broth sub-culture was unaffected.

Summary.—In this case, therefore, on the eighth day of an attack of diphtheria at least 100,000 virulent diphtheria bacilli, together with at least 250,000 streptococci, were present per cc. of the tonsillar secretion. A streptococcus, resembling the most coherent type of S. scarlatinæ in its morphological and cultural characters, was present in the tonsillar secretion to the extent of at least 100,000 cc., but was not found to be pathogenic for a mouse.

CASE VI.—F. D. Female, aged 14. Eighth day since the onset of the attack. The condition of the patient is very grave. The tonsil is sloughing, and the smell is very offensive. The following cultures were made from the tonsillar secretion :—

With $\frac{1}{50000}$ cc. a serum culture.
" $\frac{1}{100000}$ cc. do.
" $\frac{1}{100000}$ cc. a broth culture.
" $\frac{1}{150000}$ cc. do.

The result was that no diphtheria bacillus was obtained, the only organisms present in the cultures being streptococci. Sub-cultures from all four tubes showed that apparently the same streptococcus was present in each of them. The specimen specially studied was that isolated from the serum tube that had been inoculated with $\frac{1}{100000}$ cc. of the tonsillar secretion, and its characters were as follows :—

Broth one day 37° C.—The fluid is rendered turbid, and small granular flocculi are seen collected at the side and foot of the tube. Microscopically the flocculi are found to consist of a small conglomerate streptococcus. Loose chains are also plentiful, and vary in length from brevis to medius, the majority being of the brevis type. The great majority of the individuals are coccus-shaped, but at places a few are slightly elongated.

Agar condensation fluid 1 *day* 37° C.—Microscopically conglomeration is seen at places. The majority of the chains are of the brevis class, though a few reach the standard of medius. The majority of the individuals are coccus-shaped, but a few show a bacillary tendency.

Serum condensation fluid 1 *day* 37° C.—The chains are very short, none exceeding the length of S. brevis, and many diplococci being present. A massing tendency is exhibited. The individuals are mostly cocci, but a few bacillary forms are also seen.

Litmus milk 37° C.—In forty-eight hours there is a strong acid reaction, and a firm clot.

Agar colonies 1 *day* 37° C.—The growth is less profuse than in the case of S. brevis and S. pyogenes. The colonies are small, round or oval, and slightly granular. Microscopically conglomeration is well shown. Chains, though short, are not uncommon. Many of the individuals are coccus-shaped, but bacillary forms are common.

Serum growth 1 *day* 37° C.—Microscopical examination shows that a massing tendency is exhibited by the individuals, many of which are bacillary.

Gelatine growth 20° C.—In streak culture the continuity of the growth is well preserved. The growth is faster than that of typical S. scarlatinæ, but slower than that of typical S. pyogenes. Impression-preparations made on the 17th day show that the individuals are entirely coccus-shaped.

Pathogenicity.—A mouse injected with the streptococcus was dead in one day. Post-mortem the subcutaneous tissues around the site of inoculation were infiltrated with turbid exudation that was found microscopically to be crowded with the organism mostly in the form of diplococci, and in short chains. The organs were congested, and the spleen was enlarged as well as congested. Cultures from the heart's blood, spleen, kidney and liver showed no growth, but the streptococcus was recovered in pure culture from the subcutaneous exudation around the site of inoculation. The morphological and cultural characters of the streptococcus, on recovery from the mouse, were found to be unaltered. For microphotographs of the growth on the surface of serum and also in broth, see Figs. 30 and 31, Plate XIV.

Summary.—In this case, on the eighth day of an attack of reputed diphtheria, the tonsil was sloughing. Cultures made from $\frac{1}{50000}$ cc. to $\frac{1}{150000}$ cc. of the tonsillar secretion failed to yield B. diphtheriæ, but all contained a streptococcus. The streptococci present in all cultures from the tonsillar secretion appeared to be of the same kind, and resembled S. scarlatinæ in morphological and cultural

ANALYSIS showing RESULT of QUANTITATIVE EXAMINA-

Case.	Stage.	Material examined.	Approximate amount used.	Medium.
I.	4th day ..	Tonsillar secretion ..	$\frac{1}{250000}$ cc.	Serum .. ..
	Do.	Do.	$\frac{1}{250000}$ cc.	Broth .. ..
	Do.	Do.	$\frac{1}{1000000}$ cc.	Serum .. ..
	Do.	Do.	$\frac{1}{1000000}$ cc.	Broth .. ..
II.	4th day ..	Tonsillar secretion ..	$\frac{1}{50000}$ cc.	Serum .. ..
	Do.	Do.	$\frac{1}{100000}$ cc.	Serum .. ..
	Do.	Do.	$\frac{1}{100000}$ cc.	Broth .. ..
	Do.	Do.	$\frac{1}{250000}$ cc.	Broth .. ..
III.	6th day.. ..	Tonsillar secretion ..	$\frac{1}{50000}$ cc.	Serum .. ..
	Do.	Do.	$\frac{1}{100000}$ cc.	Serum .. ..
	Do.	Do.	$\frac{1}{100000}$ cc.	Broth .. ..
	Do.	Do.	$\frac{1}{250000}$ cc.	Broth .. ..
IV.	8th day.. ..	Tonsillar secretion ..	$\frac{1}{50000}$ cc.	Serum .. ..
	Do.	Do.	$\frac{1}{100000}$ cc.	Serum .. ..
	Do.	Do.	$\frac{1}{100000}$ cc.	Broth .. ..
	Do.	Do.	$\frac{1}{250000}$ cc.	Broth .. ..
V.	8th day.. ..	Tonsillar secretion ..	$\frac{1}{50000}$ cc.	Serum .. ..
	Do.	Do.	$\frac{1}{100000}$ cc.	Serum .. ..
	Do.	Do.	$\frac{1}{100000}$ cc.	Broth .. ..
	Do.	Do.	$\frac{1}{250000}$ cc.	Broth .. ..
VI.	8th day.. ..	Tonsillar secretion ..	$\frac{1}{50000}$ cc.	Serum .. ..
	Do.	Do.	$\frac{1}{100000}$ cc.	Serum .. ..
	Do.	Do.	$\frac{1}{100000}$ cc.	Broth .. ..
	Do.	Do.	$\frac{1}{250000}$ cc.	Broth .. ..
VII.	6th day.. ..	Nasal discharge ..	$\frac{1}{250000}$ cc.	Serum .. ..
	Do.	Do.	$\frac{1}{250000}$ cc.	Broth .. ..
	Do.	Do.	$\frac{1}{1000000}$ cc.	Serum .. ..
	Do.	Do.	$\frac{1}{1000000}$ cc.	Broth .. ..

TION of the TONSILLAR SECRETION during DIPHTHERIA.

B. Diphtheriæ.	Effect of same on Guinea-pig.	Streptococci.	Morph. and Cult. Characters of the same.	Effect of same on Mouse.
+	Dead in 2 days ..	+	Conglomerate, clots milk, no bacillary forms on agar.	Unaffected.
−		+		
−		+	Very conglomerate, no clot, a few spindles on agar.	Unaffected.
−		+		
+		+		
+	Dead in 2 days ..	+	Very conglomerate, clots, bacillary forms on serum and on agar.	Dead in 2 days.
−		+		
−		+		
+		+		
+	Dead in 2 days ..	+	Very conglomerate, clots, bacillary forms on serum and on agar.	Dead in 2 days.
−		+		
−		+		
+		+		
+	Dead in 30 hours	+		
−		+	S. pyogenes, no clot	Dead in 2 days.
−		+	S. pyogenes, no clot.	
+		+		
+	Dead in 18 hours	+	Very conglomerate, clots ..	Unaffected.
−		+		
−		+		
−		+		
−		+	Conglomerate, clots, bacillary forms on serum.	Dead in 1 day.
−		+		
−		+		
+		−		
+		−		
+	Dead in 2 days ..	−		
−		−		

characters. The specimen isolated from the serum tube inoculated with $\frac{1}{100000}$ cc. of tonsillar secretion was injected into a mouse, which succumbed in one day. On recovery from the mouse, the streptococcus was found to be unaltered in morphological and cultural respects.

CASE VII.—In this case there was no examination of the tonsillar secretion, but as the patient had a sanguineous, purulent discharge from the nostril, the opportunity was taken of examining it.

I. P. Female, aged 4, has a very severe attack of diphtheria. To-day, the sixth day from the onset of the disease, rhinorrhœa has begun. The following cultures were made from the nasal discharge :—

With $\frac{1}{350000}$ cc. a serum culture.
" $\frac{1}{350000}$ cc. a broth culture.
" $\frac{1}{1000000}$ cc. a serum culture.
" $\frac{1}{1000000}$ cc. a broth culture.

The results were as follows :—Both serum cultures gave a pure growth of a bacillus morphologically indistinguishable from B. diphtheriæ. The broth inoculated with $\frac{1}{350000}$ cc. of the nasal discharge also showed after a few days a pure culture of the same organism. The broth inoculated with $\frac{1}{1000000}$ of the nasal discharge, however, showed no growth at the end of a week when it was discarded.

Particulars of the organism isolated.—The diphtheria-like bacillus isolated from the serum tube that had been inoculated with $\frac{1}{1000000}$ cc. of the nasal discharge was found to also resemble B. diphtheriæ in cultural respects. A guinea-pig inoculated with 1 cc. of a 48 hours' broth sub-culture was dead in two days, and showed the appearances usually produced by B. diphtheriæ. The bacillus was recovered from the site of inoculation, but, as in previous cases, not from elsewhere.

Summary.—In this case, therefore, on the eighth day of diphtheria, and on the first day of the nasal discharge, the latter contained at least one million virulent diphtheria bacilli per cc. In $\frac{1}{350000}$ cc. also of the nasal discharge no other organism was present.

SUMMARY.

1. Bacillus diphtheriæ was present in the secretion on the surface of the tonsil in five out of six cases of severe diphtheria which were examined, and in all cases it produced a fatal result on a guinea-pig within 48 hours of injection.

2. In four cases virulent B. diphtheriæ was present in the tonsillar secretion to the extent of at least 100,000 per cc.; and in one case (Case I.), where a higher dilution was made, the bacillus was found to exceed 250,000, but to be under one million per cc. of the tonsillar secretion.

3. In all five cases where it was present, B. diphtheriæ was found to be associated in the tonsillar secretion with streptococci. These streptococci were in all cases present to the extent of at least 250,000 per cc. of the tonsillar secretion. In the single case (Case I.), where a higher dilution was made, streptococci were found to be more numerous in the tonsillar secretion than B. diphtheriæ. In that particular instance there were at least a million streptococci present per cc. of the secretion on the surface of the tonsil.

4. In one case, namely, Case VI., where the tonsil of the patient was sloughing, no B. diphtheriæ was found in $\frac{1}{5000}$ or less of the tonsillar secretion. The only organism present in the cultures was a virulent streptococcus that bore a resemblance in its morphological and cultural characters to S. scarlatinæ.

5. In two of the six cases of diphtheria examined, specimens of the streptococci that were associated with B. diphtheriæ in the tonsillar secretion were injected into a mouse, but appeared to be devoid of virulence for that animal.

6. In four of the six cases, on the other hand, the streptococci examined were found to possess virulence for a mouse. The virulent streptococcus isolated from one case resembled S. pyogenes in morphological and cultural characters; but that present in the other three cases bore a resemblance to S. scarlatinæ in the same respects.

7. A nasal discharge, which began on the sixth day of diphtheria, was found on the day of its commencement to contain one million virulent diphtheria bacilli per cc.; and no other organism was present in $\frac{1}{250000}$ cc. of it.

SECTION IV.

Scarlatinal Otorrhœa.

I am indebted to Dr. Gayton for the opportunity of examining the following seven cases of scarlatinal otorrhœa. My chief object was to see whether the "small Xerosis like bacillus," which I had previously found to occur in cultures made from the ear discharge, might not possibly in some cases be a form of S. scarlatinæ that had been overlooked at the time of the previous examination, owing to the fact that I was not then acquainted with the remarkable capacity for bacillus-formation that some strains of S. scarlatinæ exhibit. The following procedure was adopted. In each case two loopfuls of the aural discharge were distributed in about 2 cc. of sterile salt solution, and from this dilution a tube of solidified blood-serum and a surface agar plate were inoculated.

The following results were obtained :—

Case I.—W. C. Male, aged 4. Third week since the onset of scarlatina, and first day of the ear discharge. Both serum and agar cultures yielded a streptococcus in pure culture. This organism left broth clear, but grew in the form of a collection of flocculi and flakes at the foot of the tube. Microscopically, the growth was that of S. medius, but conglomeration was rather more marked than usual. In agar condensation fluid some conglomeration was seen, and also a few bacillary forms occurred here and there. In other respects the organism was indistinguishable from the usual form of S. pyogenes.

Case II.—E. H. Female, aged 5. Sixth week of scarlatina, and first day of the aural discharge. The agar plate showed Staphylococcus albus and citreus, and after a few days some minute granular irregularly outlined colonies of a small bacillus belonging to the diphtheria group. The serum tube showed several colonies of S. albus, and in the condensation fluid at the foot was the same organism together with the small bacillus of the diphtheria group.

The small bacillus was isolated from both agar and serum cultures, and subcultures of it from either source made in various media gave the same results. In broth the organism produced slight turbidity and a fine precipitate. Microscopically little groups of a small, stunted, gram-staining bacillus belonging to the diphtheria group, were visible. In agar condensation fluid, similar clumps of small, stunted bacilli often arranged in parallels and having segregated protoplasm were seen. On the surface of agar the colonies were small, granular, and with an irregular edge. Microscopically the bacilli were found to often have pointed ends; some of them were clubbed, and frequently they were arranged in

parallels. In litmus milk no change was produced at first, but after several days an alkaline reaction was seen. In the course of a month's incubation the alkaline reaction became more marked, but no clot was produced. From a sub culture of the bacillus, isolated from the serum culture, a guinea-pig was inoculated, but remaining quite unaffected.

CASE III.—F. K. Male, aged 6, had ear-ache nine days ago, followed next day by otorrhœa. The scarlatinal rash, however, did not appear till three days ago, Both serum and agar cultures show staphylococcus aureus, and a majority of streptococcus colonies. The streptococci isolated from both serum and agar had the same morphological and cultural characters. Broth was rendered turbid, and microscopically the growth was that of Streptococcus pyogenes. In agar condensation fluid there was some lace-work formation, but no bacillary forms were seen. In litmus milk an acid reaction was produced, but no clot. The growth on agar and also on gelatine did not differ from that of S. pyogenes.

CASE IV.—P. C. Male, aged 3. Eighth week from the onset of scarlatina and fifteenth day since the ear-discharge began. Both serum and agar cultures showed two kinds of organism, namely, a streptococcus and a bacillus of the diphtheria group.

In the case of the serum culture from this otorrhœa, the surface of the serum showed the bacillus alone, but in the condensation fluid, besides the bacillus, longish chains of a streptococcus were present. A point noticed about these chains when the serum culture was first examined 20 hours after inoculation was that the individuals of which they were composed showed a distinctly bacillary tendency. An agar plate was made from the serum condensation fluid, and the streptococcus thus isolated had the following characters. In broth, the fluid remained clear, and at the foot of the tube was a nebulous mass that was found microscopically to consist of long streptococcus chains exhibiting a marked tendency to conglomeration. In agar condensation fluid, lace-work pattern, conglomeration, and bacillus-formation were seen. In litmus milk, after two days, a strong acid reaction accompanied by firm clotting was seen. The growth on agar, as also on gelatine, was slower than that of the other streptococci isolated from ths aural discharges and was indistinguishable from that of S. scarlatinæ. Impression preparations of the gelatine colonies after 10 days' growth showed on careful searching some spindle and bacillary shapes, though they were by no means common.

The morphological and cultural characters of the streptococcus therefore resembled those of S. scarlatinæ. A mouse injected with it died on the 20th day, showing congested organs, an enlarged spleen, but no local lesion. From the liver two forms were recovered, one identical in morphological and cultural respects with B. conglomeratus described in my last report, and clotting milk with a strong acid reaction; the other a streptococcus identical in similar respects with the streptococcus that was also described in the same report as having been at that stage of the inquiry most frequently recovered from mice that succumbed to inoculation with S. scarlatinæ. The result of injecting a mouse with the streptococcus therefore confirmed the opinion that it was S. scarlatinæ.

From the agar plate made from the ear discharge a streptococcus similar in morphological and cultural character to S. scarlatinæ was also recovered.

The bacillus belonging to the diphtheria group, also isolated from the present case, had the following characters. Broth was left clear, growth occurring in the form of a collection of coarse powder and grains at the foot of the tube. Microscopically small clumps of short, diphtheria-like bacilli with pointed ends were seen. The bacillus stained with Gram. In agar condensation fluid also the growth consisted of small clumps of diphtheria-like bacilli. In litmus milk there was a distinctly acid reaction after three days; in the course of a month's incubation at 37° C. the acid reaction became more decided, but no clot was produced. On agar in one day at 37° C. the organism grew in the form of minute granular colonies. These increased in size so that after some days the growth was raised, opaque, and had a "pearly" lustre. A guinea-pig injected with the bacillus was unaffected.

CASE V.—G. G. Female, aged 3. Fourth week of scarlatina and 22nd day of otorrhœa. The serum culture from this case showed Sta. albus and a small bacillus of the diphtheria group but which failed to grow on sub-culture. The agar plate showed Sta. albus and Sta. citreus, a streptococcus, and some minute granular colonies of a small bacillus of the diphtheria group.

The streptococcus isolated from the agar plate had the following characters. Broth was left clear and flocculi were seen at the foot of the tube. Microscopically the growth was that of S. pyogenes, but conspicuous conglomeration was also present. The conglomeration was, in fact, as marked as in the case of the growth in broth of the streptococcus recovered most frequently from the scarlatinal cadaver. In agar condensation fluid conglomeration was marked and chains were also plentiful, but no bacillary forms were seen. In litmus milk an acid reaction, but no clot was produced. In its growth on agar and on gelatine the streptococcus was indistinguishable from S. pyogenes.

The bacillus isolated from the agar plate left broth clear and formed flakes and dust at the foot of the tube. Microscopically the organism was found to be a Gram-staining bacillus of the diphtheria group, showing a tendency to aggregate into little clumps. In litmus milk an acid reaction was produced after a few days In the course of a month's incubation the acid reaction was increased, but no clotting took place. The growth on agar was in the form of minute granular colonies. In these and in other morphological respects the bacillus was identical with that isolated in Case IV.

Case VI.—E. V. Female, aged 7. Fourth week of scarlatina and 22nd day of otorrhœa. The serum culture made from the discharge gave a pure culture of streptococcus. The agar plate showed the same organism in an overwhelming majority, with a few colonies of Sta. citreus and some small granular colonies of a bacillus belonging to the diphtheria group.

The streptococcus isolated from the serum and also from the agar plate grew in broth in the form of flakes and flocculi, leaving the fluid clear. Microscopically the appearance was similar to that of S. pyogenes. Conglomeration was seen at places. In agar condensation fluid lace-work was present, and some of the individuals showed a slightly bacillary tendency. In litmus milk an acid reaction was produced, but no clot. The growth on agar and on gelatine was indistinguishable from that of S. pyogenes.

The bacillus isolated from the agar plate left broth clear, forming a few small granules at the foot of the tube. Microscopically these were found to be small clumps of a Gram-staining bacillus of the diphtheria group. In litmus milk, after a few days, an alkaline reaction was produced. In a month the alkaline reaction became more marked, but there was no clotting. On the surface of agar the bacillus grew in the form of small granular colonies.

Case VII.—M. Female, aged 5. Fifth week of scarlatina, 22nd day of otorrhœa. The serum culture showed many colonies of bacilli of the diphtheria type. The agar plate showed, besides these, a few colonies of Sta. aureus. No streptococcus was isolated.

The bacillus present in the serum tube had the following characters. Broth was made to appear turbid from the presence of numerous minute flocculi. Microscopical examination showed that the minute flocculi consisted of bacilli having pointed ends, retaining Gram's stain, and morphologically resembling B. diphtheriæ. In litmus milk an acid reaction was clearly perceptible in the course of 48 hours, and after a month, though acidity was well marked, no clot was produced. On agar the growth consisted of round, opaque, raised colonies that after some days acquired a faintly yellow tint. Microscopically it was found that clubs and segregated protoplasm were features of the bacillus on this medium. A guinea-pig inoculated with 1 cc. of a 48 hours' broth sub-culture of the bacillus died on the seventh day, showing the appearance usually produced by B. diphtheriæ. The organism was recovered by making a serum culture from the exudation at the site of inoculation.

From the agar plate made with the dilution from this ear discharge, however, besides a bacillus morphologically and culturally resembling the above, another Gram-staining bacillus belonging to the diphtheria group was isolated. In broth slight general turbidity was produced by the organism, and microscopically little clumps formed of pointed bacilli were seen In agar condensation fluid the appearance was similar to that in broth. In litmus milk an alkaline reaction was produced, but no clot. The agar colonies were small—smaller in fact than those of S. pyogenes—circular in shape, and of smooth consistency. Microscopically the individuals of which they were composed were seen to be pointed bacilli, here and there clubbed, and a minority showing slightly segregated protoplasm. A guinea-pig injected with 1 cc. of a 48 hours' broth culture was unaffected.

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On the Bacteriology of Scarlatina; by Dr. Gordon.

Summary.—The result of further investigation of the scarlatinal ear-discharge, therefore, has been that in none of the seven cases examined have any of the bacilli present been found to admit of identification with a bacillus-forming strain of S. scarlatinæ. On the other hand the bacilli met with in scarlatinal otorrhœa admit of differentiation into two main classes according as they produce an acid or an alkaline reaction in litmus milk. The former appear to approach B. diphtheriæ in this and in some cases in other respects, while the alkali-producing bacilli appear to resemble either B. Hofmann or B. Xerosis.

In five of the seven cases examined the ear-discharge contained a streptococcus. In four cases the streptococcus present could not on morphological and cultural grounds be identified with S. scarlatinæ, but in one case (Case IV.) the streptococcus isolated from the ear-discharge could from its morphological and cultural characters, and also from the result of injecting a mouse, be identified with S. scarlatinæ.

SECTION V.

THE EFFECT ON STREPTOCOCCUS SCARLATINÆ OF PASSING IT THROUGH ANIMALS.

The observations on this subject recorded in last year's report may be briefly recapitulated as follows. As the result of passage through a mouse, it was found that a change in the features of S. scarlatinæ was apt to take place in one of two directions. In some cases the morphological and cultural individuality of the organism, especially the bacillus-forming capacity, so far from undergoing diminution, became actually more marked. More frequently, however, it was found that the morphological and cultural individuality tended towards becoming lost. But although some of the distinctive characters were thus suppressed, others, such as bacillus-formation in various media, and the lacework arrangement of the growth in agar condensation fluid, sufficed, in the extent to which they were exhibited, to still distinguish the modified form of S. scarlatinæ recovered from the tissues of the mouse from Streptococcus pyogenes. Accompanying this tendency to loss of morphological and cultural individuality, an increase of virulence appeared to be in some cases acquired by S. scarlatinæ.

In one instance where, as the result of passage through a mouse, Streptococcus scarlatinæ had become modified in the latter direction, the experiment of passing it through a guinea-pig had been made. When recovered from the heart's blood of the guinea-pig the organism was found to have undergone further modification, and to be with difficulty distinguished from S. pyogenes. Bacillus-formation had now become lessened, no longer being visible in impression-preparations of the gelatine colonies, and it was only by dint of its behaviour in agar colonies and in condensation fluid, and also by the extent of the lace-work formation in agar condensation fluid, that the streptococcus recovered from the guinea-pig could be distinguished from streptococcus pyogenes.

When discussing the bacteriology of the scarlatinal cadaver in last year's report, these facts were taken in account. In only two of the 10 fatal cases of scarlatina examined could the organism present be immediately identified with S. scarlatinæ. In three of the remaining eight cases, however, owing chiefly to the extent to which the streptococcus obtained from them possessed the power of forming spindle and bacillary forms in culture, identity with S. scarlatinæ was eventually established. In altogether five of the 10 cases examined after death from scarlatina, therefore S. scarlatinæ was eventally recognised. But in the five other cases I was unable to say more than that it was highly probable that the streptococcus present in the blood and organs was a modified form of S. scarlatinæ. This probability was based on the fact that the streptococcus obtained from these cases had the same characters as the streptococcus recovered from the guinea-pig in the single instance where the mouse Streptococcus scarlatinæ had been then passed through that animal.

The chief difficulty with regard to the streptococcus most frequently recovered from the scarlatinal cadaver lay in its resemblance to Streptococcus pyogenes. In only one or two special characters (such as conglomeration, lace-work, and bacillus-formation) could it be distinguished from that organism; and it was not so much in the presence or absence, as in the relative *extent* to which these characters were exhibited, that difference between this streptococcus of the scarlatinal cadaver and S. pyogenes could be detected.

It was desirable therefore that further evidence should be sought with regard to the effect of passage through animals on the characters of S. scarlatinæ of the tonsillar secretion in the mild type of scarlatina. The main question requiring elucidation was—Does streptococcus scarlatinæ invariably undergo modification of its morphological and cultural characters, to the extent of loss of individuality, by passage through animals: and, if so, can a stage be reached when it is morphologically and culturally indistinguishable from examples of Streptococcus pyogenes?

The experiments mentioned in last year's report, in which S. scarlatinæ had been passed through animals, were (with the single exception of one sample of nasal discharge) all carried out with specimens isolated from the throat, of scarlatinal cases, by means of agar plates. In the following cases, however, the medium on which S. scarlatinæ was in the first place isolated was in several instances solidified blood-serum. Altogether, eight specimens of Streptococcus scarlatinæ have been investigated. They were obtained from seven sources. I will describe them in the order of the stage of scarlatina in which they were isolated.

No. I.—This specimen was isolated from the tonsillar secretion of a patient on the second day of scarlatina. The case was the earliest one of scarlatina that I have yet had the opportunity of examining. Details of the bacteriological examination will be found in a previous section: section III., tonsillar secretion during scarlatina, Case I. A serum culture inoculated with approximately $\frac{1}{150000}$ cc. of the tonsillar secretion of the patient yielded two different organisms, one a virulent streptococcus indistinguishable from Streptococcus pyogenes, the other the

present example of Streptococcus scarlatinæ. The morphological and cultural characters of both streptococci have been described in detail. This example of S. scarlatinæ was injected into a mouse (mouse 1), which succumbed on the third day. Post-mortem—its organs showed congestion, and the spleen was enlarged. There was no suppuration at the site of inoculation. Cultures from the spleen and kidney of the mouse gave pure growths of S. scarlatinæ. The morphological and cultural characters of the streptococcus on recovery from the mouse were re-examined. The only modification that had taken place was with regard to the rate of growth on gelatine, which was now a little faster than originally. In other respects the streptococcus recovered from the spleen of the mouse was unaltered; bacillus-formation, acid production, and the clotting of milk being the same as before. In morphological and cultural respects, therefore, the streptococcus when recovered from the spleen of the mouse was practically unaltered. For micro-photograph of the growth on serum, *see* Fig. 19, Plate XI.

From a 48 hours' broth sub-culture from a single colony in the agar plate, made from the spleen of the mouse, another mouse and a guinea-pig were inoculated.

The guinea-pig was dead in two days. Post-mortem—the kidneys and liver were congested, but the spleen was neither congested nor enlarged. The suprarenal capsules were much enlarged, and on section were seen to be engorged with blood. The vessels in the subcutaneous tissues around the site of inoculation appeared to be injected, but there was no suppuration. Cover glass preparations from the heart's blood, spleen, kidney, and liver revealed no organisms, and cultures made from the same localities remained sterile. Although the guinea-pig died within two days of injection, therefore, no growth was obtained from its blood or organs.

The mouse (mouse 2), also inoculated from the same culture, died on the ninth day, showing congested organs, enlarged spleen, and suppuration at the site of inoculation. Agar cultures were made from the heart's blood, spleen, kidney, liver, and from a dilution of the pus at the site of inoculation. All cultures remained sterile except that from the pus, which gave a pure culture of the streptococcus. On re-examination it was found to be in morphological and cultural respects the same as before.

For micro-photographs of the growth of the streptococcus both in broth and on the surface of blood-serum, *see* Figs. 20 and 21, Plate XI.

Summary of No. I.—An example of Streptococcus scarlatinæ, isolated from $\frac{1}{250000}$ cc. of the tonsillar secretion of a patient on the second day of scarlatina, is unaltered in its morphological and cultural characters by passage through two mice in succession. After passage through the first mouse it did not appear that its pathogenicity for the mouse was raised, for a second mouse inoculated with the streptococcus when recovered from the spleen of mouse 1. did not succumb till the ninth day; a guinea-pig, however, inoculated at the same time, and from the same culture as the second mouse, was dead in two days. Cultures made from the

blood and organs of the guinea-pig gave no growth. Cultures made from the blood and organs of the second mouse also gave no growth; but the streptococcus was recovered from pus near the site of inoculation. When recovered from the second mouse, Streptococcus scarlatinæ was found to be unaltered in morphological and cultural characters.

An example of Streptococcus scarlatinæ, therefore, present in the secretion on the surface of the tonsil on the second day of scalatina, to the extent of at least 250,000 per cc., was unaltered in morphological and cultural respects by passage through two mice in succession, It may here be observed that the example of Streptococcus pyogenes, also present in the tonsillar secretion of this patient to the extent of at least 250,000 per cc., was equally unaltered, in morphological and cultural respects, by passage through a mouse.

No. II.—This specimen of S. scarlatinæ was isolated from the tonsillar secretion of a patient on the third day of scarlatina. The result of the bacteriological examination of the tonsillar secretion will be found in a previous section: Section III., tonsillar secretion during scarlatina, Case II. A serum culture, inoculated with approximately $\frac{1}{100000}$ cc. of the tonsillar secretion of the patient, yielded two different organisms—one a virulent example of S. pyogenes, the other indistinguishable in morphological and cultural respects from S. scarlatinæ, but devoid of virulence for a mouse. Recourse was, therefore, had to the agar plate made from $\frac{1}{50000}$ cc. of the tonsillar secretion, and a streptococcus indistinguishable, in morphological and cultural respects, from S. scarlatinæ was thus isolated. A mouse (mouse 1), inoculated with this example of S. scarlatinæ, succumbed on the tenth day, showing the appearance usually produced by S. scarlatinæ. There was suppuration at the site of inoculation, and microscopical examination of the pus showed the streptococcus *in situ* chiefly in the form of diplococci and short chains. A massing tendency was also obvious in places. The streptococcus was thus recovered from the pus at the site of inoculation, not from elsewhere; but, as putrefaction had begun, any streptococcus colonies present in the cultures from the blood and organs of the mouse would have been overlooked. The streptococcus recovered from the pus was re-examined, and found to be unaltered in morphological and cultural respects. It was now injected into a second mouse (mouse 2), which died on the ninth day. The streptococcus was again recovered from pus at the site of inoculation, but not from elsewhere—cultures from the blood and organs of the mouse showing no growth of any kind. The streptococcus was found to be unaltered in morphological and cultural respects when recovered from the second mouse. The streptococcus was now injected into a third mouse (mouse 3). The mouse died on the tenth day. The streptococcus was again recovered from pus at the site of inoculation, but not from elsewhere; and again it was found to be unaltered in morphological and cultural respects.

Summary of No. II.—This example of S. scarlatinæ isolated from an agar plate inoculated with $\frac{1}{50000}$ cc. of the tonsillar secretion of a patient on the third day of scarlatina, was unaltered in morphological and cultural respects after having caused a

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fatal disease in three mice in succession. Nor did its virulence for the mouse appear to be raised. It may be again observed that an example of S. pyogenes also isolated from $\frac{1}{100000}$ cc. of the tonsillar secretion of the same patient was equally unaltered in morphological and cultural respects on recovery from a mouse which succumbed to it on the 8th day.

No. III.—Three different streptococci were isolated from a serum culture made from $\frac{1}{100000}$ cc. of the tonsillar secretion of this case on the fourth day of scarlatina. The result of the bacteriological examination of the tonsillar secretion was described above. See Section III., Tonsillar Secretion during Scarlatina, Case IV.

Streptococcus 1.—The first organism was indistinguishable in morphological and cultural respects from S. pyogenes. A mouse injected with it died in 48 hours and the streptococcus was recovered from its blood and organs in pure culture. The morphological and cultural characters of the streptococcus after passage through the mouse were re-examined and found to be unaltered.

Streptococcus 2.—The second organism isolated from the serum culture had all the morphological characters of S. scarlatinæ, and also all the cultural characters of that organism save one; namely, that in litmus-milk there was only a slightly acid reaction, and no clotting was effected. As examples of S. scarlatinæ that did not produce a strong acid reaction and did not clot milk, had been previously isolated from scarlatinal throats, the fact that this organism also failed in these two respects to coincide with typical S. scarlatinæ was not held to disqualify it from being considered a strain of that organism. Its characters were as follows:—

Broth one day 37° C.—The streptococcus leaves the fluid clear and grows in the form of a coherent, conglomerate mass at the foot of the tube. Microscopically the appearance is indistinguishable from that of the most coherent type of S. scarlatinæ. The individuals are entirely coccus-shaped.

Agar condensation fluid two days 37° C.—The streptococcus grows in coherent masses that are with difficulty sufficiently separated for microscopical examination. The individuals are entirely coccus-shaped.

Serum condensation fluid one day 37° C.—Chains are better developed than in the preceding media. A tendency to massing is seen. The individuals are entirely cocci.

Litmus milk 37° C.—There is a feeble acid reaction after two days. In one week there is fair acidity, but no clot.

Agar colonies one day 37° C.—The growth is less profuse than in the case of S. pyogenes. In shape and markings (nodulation) the colonies are indistinguishable from colonies of S. scarlatinæ. Microscopically cocci are in the majority, but bacillary forms are also numerous.

Serum growth one day 37° C.—The growth shows very marked conglomeration, and requires crushing in between two cover glasses in order to get it thin and separated enough for microscopical examination. When separated out in this way, many of

the individuals are seen to have either a spindle or a bacillary tendency; see Fig. 22, Plate XII.

Gelatine growth 20° C.—The growth is as slow as that of S. scarlatinæ usually is on this medium. The colonies as time went on showed nodulation. Impression-preparations made on the 10th day showed some good spindles and bacillary forms at places.

A mouse injected with a 48 hours broth sub-culture of the organism was dead on the 4th day. The result of the post-mortem examination was as follows:—At the site of inoculation suppuration had taken place. There was suppurative peritonitis. Abscess was seen in the liver and also in one kidney. The spleen was congested and enlarged. Cover-glass preparations of the pus, whether from the site of inoculation, from the liver, kidney, or peritoneal cavity had the same microscopical appearance; in each case being crammed with the streptococcus chiefly arranged in the form of diplococci, but also in short chains, and showing at places a tendency to conglomeration; see Fig. 23, Plate XII. Cultures made from the pus at the site of inoculation, heart's blood, spleen, kidney, liver, and peritoneal cavity, all yielded the same streptococcus. On examination of the morphological and cultural characters of this organism, however, they were found to be *different* from those of the organism injected.

The streptococcus recovered from all these sources in the mouse had the following characters.

Broth one day 37° C.—The fluid remains clear and flocculi are collected at the foot of the tube. Microscopically conspicuous conglomeration is seen, but not coherency. The chains are of medium length, and the individuals are entirely coccus shaped.

Agar condensation fluid two days 37° C.— Microscopical examination shows that though lace-work is present, it is not extensive. Among a great majority of cocci a few bacillary forms are seen.

Serum condensation fluid two days 37° C.—Chains of medium length are seen composed entirely of cocci. Indistinguishable from the growth of S. pyogenes in this medium.

Litmus milk 37° C.—In two days, feeble acid. In one week, fair acid but no clot.

Agar colonies one day 37° C.—Both macroscopically and microscopically indistinguishable from S. pyogenes.

Serum growth one day 37° C.—No conglomeration or coherency; no bacillary forms; indistinguishable from S. pyogenes (Fig. 24, Plate XII.).

Gelatine colonies 20° C.—Both macroscopically and microscopically indistinguishable from S. pyogenes. After being kept in culture for five months the gelatine growth was again examined by impression preparations. It was still indistinguishable from the growth on gelatine of S. pyogenes.

Summary of No. III.—By passage through a mouse, therefore, this streptococcus which, when isolated from the secretion on the surface of the scarlatinal tonsil, had the characters of streptococcus

scarlatinæ, except that it did not produce a strongly acid reaction and did not clot milk had become changed. When recovered from the mouse, all the characters by which it was distinguished from S. pyogenes had disappeared. It was, in fact, now indistinguishable from streptococcus No. 1 isolated from the same source.

No. IV.—*Streptococcus* 3.—The third streptococcus isolated from the serum tube inoculated with $\frac{1}{100000}$ cc. of the tonsillar secretion of the preceding case was indistinguishable from the examples of S. scarlatinæ isolated from Cases I. and II. In broth, coherency was much less marked than in the case of streptococcus II. In Litmus-milk a strong acid reaction and firm clotting were produced in 48 hours. Bacillus-formation was seen in the growth on solid media. A mouse (mouse 1) inoculated with a 48 hours' broth sub-culture was dead on the third day. The organism was recovered from the pus at the site of inoculation but not from elsewhere. It was found to be unaltered in morphological and cultural respects. A second mouse and a guinea-pig were now inoculated. The guinea-pig was dead in three days and showed congested organs and enlarged suprarenal capsules, but no organisms were demonstrated *in situ*, and cultures from the heart's blood, spleen, kidney, and liver showed no growth. The mouse (mouse 2) died on the 13th day. The streptococcus was recovered from pus at the site of inoculation and also from the spleen and kidney of the mouse in pure culture, and re-examined. It was found to be still unaltered in morphological and cultural respects. A third mouse was now inoculated. The mouse (mouse 3) was a young one and small. It was dead in 48 hours and the streptococcus was recovered from its heart's blood, spleen, kidney, and liver in pure culture, and was found to be still unaltered in morphological and cultural respects. For a microphotograph of the growth on serum after recovery from the last mouse, *see* Fig 25, Plate XII.

Summary of No. IV.—The morphological and cultural characters of this example of S. scarlatinæ were unaltered after passage through three mice in succession. The fact that the third mouse died in a shorter time, than the two previous ones was probably due to its being a young one.

No. V.—This specimen of S. scarlatinæ was obtained from the tonsillar secretion of a patient on the fifth day of scarlatina. The result of the bacteriological examination of the case has been previously described. See Section III.: tonsillar secretion during an attack of scarlatina, Case VI. The organism was obtained in a different way to the other examples of S. scarlatinæ. A serum tube inoculated with approximately $\frac{1}{100000}$ cc. of the tonsillar secretion of the patient gave what appeared to be a pure culture of S. scarlatinæ. After 48 hours' incubation at 37°C. the whole of the growth was scraped off the serum culture, suspended in 1 cc. of sterile broth, and a half of it injected into a mouse, the other half into a guinea-pig. The guinea-pig was unaffected, but the mouse died on the fifth day showing congested organs, an enlarged spleen, and pus at the site of inoculation. Cultures from the blood and organs of the mouse showed no growth, but the pus showed Streptococcus scarlatinæ in situ and gave also a pure culture of it.

The example of S. scarlatinæ obtained in this way was found to have all the morphological and cultural characters of that organism. A second guinea-pig was inoculated with 1 cc. of a 48 hours' broth sub-culture of it. The guinea-pig died on the seventh day showing as usual congested organs, and enlarged suprarenal capsules. Cultures made from its blood and organs all remained, as usual, sterile. In the case of this guinea-pig, however, particular attention was paid to the site of inoculation when making the post-mortem examination. The tissues around were engorged, but no suppuration was seen. The subcutaneous exudation, which was a clear fluid, showed no organisms on microscopical examination, and also gave no growth. But while making the local examination an enlarged lymphatic gland had been seen, and a culture from it gave a pure growth of streptococcus scarlatinæ.

Four colonies of this streptococcus were sub-cultured and tested in various media. They were all exactly alike in the macroscopic appearance of their growth, and they all clotted litmus milk with a strongly acid reaction in 48 hours. Bacillus-formation was seen in all cases, but in the case of one of them was particularly well marked when growing in serum condensation fluid; see Figs. 27 and 28, Plate XIII.

Summary of No. V.—This example of S. scarlatinæ was obtained by direct injection of a mouse with the 48 hours' growth of a serum culture inoculated with $\frac{1}{10000}$ cc. of tonsillar secretion. When recovered from the mouse, the morphological and cultural characters of S. scarlatinæ were unaltered. A guinea-pig injected with the same material as the mouse was unaffected, but a second guinea-pig injected with the streptococcus when recovered from the mouse, died on the seventh day, and S. scarlatinæ was recovered from a swollen lymph gland near the site of inoculation; cultures from the blood and organs remaining as usual sterile. S. scarlatinæ when recovered from the guinea-pig was found to have suffered no diminution of the morphological and cultural characters that distinguish it from S. pyogenes.

NO. VI.—This example of S. scarlatinæ was isolated from a case of scarlatina during the fifth week from the onset of the disease. The dilution of the tonsillar secretion was not measured, and the streptococcus was isolated from it by making an agar plate. The organism was identical in morphological and cultural respects with S. scarlatinæ, and was described and figured in last year's report. (*See* Report of Medical Officer, Local Government Board, 1899–1900. P. 398, No. 55, and Figs. 3, 4, 5, 6, Plate XXI.)

A mouse (mouse 1) injected with the streptococcus died on the ninth day. From its liver both S.* conglomeratus and the "mouse streptococcus scarlatinæ" were recovered. From pus at the site of inoculation, however, the streptococcus injected was recovered and found to be unaltered in morphological and cultural respects.

A guinea-pig inoculated at the same time as the mouse was unaffected. With the streptococcus recovered from the pus at the site of inoculation of mouse 1, and found to be unaltered in morphological and cultural respects, a second mouse and a second guinea-pig were inoculated. Mouse No. 2 died on the fourth day,

* In this and in some other cases of S. scarlatinæ or conglomeratus on recovery from the mouse, bacillary forms were increased. In last year's report, the term "Bacillus conglomeratus" was used in reference to marked instances of such increase in bacillary individuals.

showing congested organs, an enlarged spleen, and pus at the site of inoculation. The streptococcus was recovered from the pus, but not from elsewhere. On examining its morphological and cultural characters, they were found to be unaltered. Guinea-pig No. 2, inoculated with the same culture, and at the same time as mouse No. 2, died on the tenth day, showing congested kidneys and liver, and enlarged suprarenal capsules; but, as usually the case with guinea-pigs that die after inoculation with S. scarlatinæ, the spleen was neither enlarged nor congested. Cultures made from the heart's blood, spleen, kidney, and liver of this guinea-pig showed no growth.

Summary of No. VI.—This specimen of S. scarlatinæ isolated from the secretion on the surface of the tonsil of a patient during the fifth week from the onset of scarlatina produced a fatal result on a mouse nine days after inoculation. A guinea-pig inoculated at the same time as the mouse was unaffected. From the liver of the mouse S. conglomeratus and the "mouse S. scarlatinæ" were recovered. From the pus at the site of inoculation of the same animal S. scarlatinæ, unaltered in morphological and cultural respects, was recovered and injected into a second mouse and a second guinea-pig. Mouse No. 2 died on the fourth day, and the streptococcus was recovered from the pus at the site of inoculation, and found to be unaltered in morphological and cultural respects. Guinea-pig No. 2 died on the tenth day, and cultures from its blood and organs showed no growth. This example of S. scarlatinæ, therefore, was not altered in morphological and cultural respects on recovery from the second mouse.

No. VII.—The case from which this example of S. scarlatinæ was isolated was one of those in which the symptoms were not sufficiently typical of scarlatina to justify the clinical diagnosis of the disease. Since the patient desquamated, however, there can be little doubt as to the nature of the malady.

The streptococcus was isolated from a surface agar plate made from a swab that had been rubbed on the tonsil and fauces. The organism grew in *broth* in the form of a nebulous mass at the foot of the tube, the fluid remaining quite clear. Microscopically the growth consisted of long chains showing considerable tendency to conglomeration at places. The majority of the individuals were round or oval, but some were slightly rod-shaped. In *litmus milk* a strong acid reaction and firm clotting were produced in forty-eight hours. The growth on *agar* was that of S. scarlatinæ; that is to say, it was less extensive than in the case of S. pyogenes, several of the colonies were nodulated, and microscopically bacillary forms were numerous. On *gelatine* the growth was slow, and impression preparations made on the fifth day showed some spindle and bacillary forms.

A mouse inoculated with the streptococcus died on the eighth day. Post-mortem there was no suppuration at the site of inoculation, but a neighbouring lymphatic gland was enlarged and softened, and a cover glass preparation from it was found to be swarming with the streptococcus, chiefly in the form of diplo-cocci. The organs of the mouse were congested, and the spleen was enlarged. The streptococcus was recovered from the heart's blood, spleen, kidney, lung, and also from the local lymphatic gland.

From whatever source in the mouse it was obtained, the streptococcus had the following characters:—In *broth* general turbidity was produced, and a loose precipitate; microscopically, chains were of medium length, and conglomeration was exhibited at places; many of the individuals showed a bacillary tendency. In *agar condensation fluid* some lacework was seen, but it was not extensive; bacillary forms were not uncommon. In *serum condensation fluid* chains were extremely well developed, and the great majority of the individuals were coccus-shaped, though several bacillary forms were also seen. *Litmus milk* showed a strong acid reaction and firm clotting in forty-eight hours. On *agar* the growth was much faster than prior to passage through the mouse, and was now in fact as copious as the growth of S. pyogenes on the same medium; microscopically, bacillus formation was very well marked. On *serum* there was very fair growth, and here again bacillary forms were to be seen by no means infrequently. The growth on *gelatine* was much faster than at first, and was now in fact as fast as that of S. pyogenes; impress-preparations on the fifth day showed very few definitely bacillary forms, though an oval or semi-bacillary tendency was not rare.

Summary of No. VII.—The streptococcus had, therefore, undergone some modification by passage through a mouse. The power of clotting litmus milk with a strong acid reaction was maintained, and bacillus-formation was still marked. On the other hand the *macroscopical* appearance of the growth in broth, on agar, and on gelatine, which was in the first place quite different from that of S. pyogenes, was now indistinguishable from the same. Some of the characters distinguishing the streptococcus from S. pyogenes had therefore vanished, but the extent of bacillus-formation, and the production of a strong acid reaction accompanied by clotting in litmus milk, still distinguished the streptococcus recovered from the mouse from S. pyogenes.

NO. VIII.—The streptococcus in the present instance was isolated from a scarlatinal ear-discharge. The patient was in the eighth week of scarlatina, and it was the 15th day of the otorrhœa. A serum culture made from a dilution of the ear discharge yielded the streptococcus together with a small bacillus belonging to the diphtheria group.

The characters of the streptococcus, which have been described previously, were as follows. In *broth* the fluid remained clear and at the foot of the tube was a nebulous mass of growth that was found microscopically to consist of long streptococcus chains exhibiting a marked tendency to conglomeration. In *agar condensation fluid* there was seen lace-work pattern, conglomeration, and bacillus-formation. In *litmus milk* a strong acid reaction and firm clot was present in 48 hours. The growth on *agar* and on *gelatine* was indistinguishable from that of S. scarlatinæ, bacillary forms being seen in both.

A mouse injected with a 48 hours broth sub-culture of the streptococcus died on the 20th day. Post-mortem no local suppuration was seen, but the organs were congested, and the spleen enlarged. From the liver of the mouse a form of S. conglomeratus that clotted litmus-milk in 48 hours with a strong

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acid reaction was recovered together with an example of the "mouse streptococcus scarlatinæ," described in last year's report. This streptococcus obtained from the liver of the mouse made broth turbid, and microscopically short to medium chains composed entirely of coccus forms were seen. In agar condensation fluid lace-work was seen, but not extensively, and a few bacillary forms were also present. In litmus-milk a feeble acid reaction was produced, and no clotting occurred. The growth on agar and on gelatine was indistinguishable from that of S. pyogenes to the eye, but microscopically bacillary forms were present in the case of this streptococcus. On serum also a few bacillary individuals were seen among a majority of coccus-shaped forms.

Summary of No. VIII.—This streptococcus, when isolated from an ear-discharge, was found to have the morphological and cultural characters of one type of S. scarlatinæ. A mouse inoculated with it succumbed on the 20th day. From the liver of the mouse was recovered S. conglomeratus, and "the mouse S. scarlatinæ." In this case, therefore, modification took place in the two directions indicated in last year's report.

ANALYSIS SHOWING THE EFFECT ON S. SCARLATINÆ OF PASSING IT THROUGH ANIMALS.

No.	Amount of Tonsillar Secretion from which specimen was obtained.	Stage of Scarlatina.	Medium used.	Mouse.	Guinea-pig.	Effect on Morphological and Cultural Characters of Strepto-coccus.
I.	$\frac{1}{150000}$ cc.	2nd day..	Serum ..	Mouse 1 died 3rd day. Organism recovered from spleen. Mouse 2 died 9th day. Organism recovered from local pus.	G-pig injected with organism when recovered from spleen of mouse 1 died 2 days. No growth obtained.	Unaltered on recovery from second mouse in succession.
II.	$\frac{1}{50000}$ cc.	3rd day..	Agar ..	Mouse 1 died 10th day. Mouse 2 died 9th day. Mouse 3 died 10th day. Organism recovered from local pus in all three.		Unaltered on recovery from third mouse in succession.
III.	$\frac{1}{100000}$ cc.	4th day .	Serum .	Mouse died 4th day. Organism recovered locally and from all organs.		Altered on recovery from the mouse.

ANALYSIS SHOWING THE EFFECT ON S. SCARLATINÆ OF PASSING IT THROUGH ANIMALS—*continued.*

No.	Amount of Tonsillar Secretion from wh ch specimen was obtained.	Stage of Scarlatina.	Medium used.	Mouse.	Guinea-pig.	Effect on Morphological and Cultural Characters of Strepto-coccus.
IV.	$\frac{1}{100000}$ cc.	4th day..	Serum ..	Mouse 1 died 3rd day. Organism recovered from local pus. Mouse 2 died 13th day. Organism recovered from local pus. Mouse 3 died 2nd day. Organism recovered from all organs.	G-pig injected with organism when recovered from local pus of mouse 1, died 3 days. No growth obtained.	Unaltered on recovery from third mouse in succession.
V.	Do.	5th day..	Do.	Mouse injected with mixed growth of serum culture died 5th day. Organism recovered locally.	G-pig No. 1, injected with the same material as mouse 1, unaffected. G-pig No. 2, injected with culture from mouse 1, died 7th day. The organism was recovered.	Unaltered on recovery both from the mouse and from the guinea-pig.
VI.	Not measured.	5th week	Agar ..	Mouse 1 died 9th day. Organism recovered from local pus. Mouse 2 died 4th day. Organism recovered from local pus.	G-pig No. 1, injected with the same culture as mouse 1, unaffected. G-pig No. 2, infected with same culture as mouse 2, died 10th day. No growth obtained.	Unaltered on recovery from second mouse in succession.
VII.	Not measured.	"Some weeks."	Agar ..	Mouse died 8th day. Organism recovered from all organs.		Altered on recovery from the mouse.
VIII.	Ear-discharge, No. 4.	8th week Scarlatina, 15th day discharge.	Serum ..	Mouse died 20th day. Liver yields B. conglom. and "mouse S. Scarlatinæ."		Altered on recovery from the mouse.

SUMMARY OF SECTION V.

1. Out of eight streptococci, isolated from scarlatinal patients, and closely resembling or identical with Streptococcus scarlatinæ, five were found to be unaltered in morphological and cultural respects on recovery from mice that succumbed to inoculation with them. On several occasions when one of the five streptococci, recovered from a mouse and found to be unaltered in morphological and cultural respects, was injected into further mice, no increase of virulence for the mouse was exhibited. These five examples of Streptococcus scarlatinæ that retained their morphological and cultural individuality had all been isolated in the first place from the secretion on the surface of the tonsil of a patient undergoing an attack of scarlatina, and all clotted litmus milk with a strong acid reaction.

2. A streptococcus (No. 3) present in the tonsillar secretion with one of these unaltered streptococci, and having the morphological and cultural characters of S. scarlatinæ, except that no strong acid reaction and no clot was produced in litmus milk, underwent such modification in passing through a mouse that the organism recovered from the mouse was indistinguishable in morphological and cultural respects from Streptococcus pyogenes.

3. A streptococcus (No. 7), isolated from the throat of a case of suspected scarlatina, was found to have undergone some modification when recovered from the blood and organs of a mouse that succumbed to inoculation with it. But, although on recovery from the mouse its morphological and cultural individuality was diminished, the streptococcus could still be distinguished from Streptococcus pyogenes.

4. An example of S. scarlatinæ (No. 8) isolated from an ear discharge, as the result of passage through a mouse underwent modification in the two directions described in the last report.

5. On several occasions, when a mouse succumbed to inoculation with Streptococcus scarlatinæ the organism was only recovered from the site of inoculation. Congestion of the organs and enlargement of the spleen was, however, present in these cases.

6. S. scarlatinæ when isolated from the tonsillar secretion of a case of scarlatina, does not appear to be pathogenic to the guinea-pig. When, however, the same organism—unaltered apparently in morphological and cultural respects—is recovered from a mouse that has succumbed to it, injection of it into a guinea-pig is now followed, in some cases, by a fatal result. In all cases where such a guinea-pig succumbed, the organs were congested and suprarenal capsules enlarged, but all cultures made from the blood and organs remained sterile. In one recent case, however (No. 5), where cultures from the blood and organs of the guinea-pig were sterile, a culture made from an enlarged lymphatic gland

near the site of inoculation gave a pure growth of S. scarlatinæ. The organism recovered from the lymphatic gland of this guinea-pig was found to have lost none of the morphological and cultural characters that distinguish Streptococcus scarlatinæ from Streptococcus pyogenes.

SECTION VI.

The Further Comparative Study of Streptococcus Pyogenes.

As S. scarlatinæ occurs in the secretion on the surface of the tonsil during an ordinary attack of scarlatina, its characters are so different from those of Streptococcus pyogenes that the risk of confusing the two organisms is a superficial one. Moreover, the recent experiments described in the preceding section show that some examples of S. scarlatinæ are unaltered by passage through a succession of mice, so that in their case there is no reason to suppose that the morphological and cultural individuality of S. scarlatinæ is otherwise than permanent.

But, besides Streptococcus scarlatinæ, virulent specimens of Streptococcus pyogenes have been isolated on some occasions from the tonsillar secretion of a case of ordinary uncomplicated scarlatina. All such specimens of S. pyogenes have been re-examined in morphological and cultural respects after passage through a mouse, and on no occasion as yet has any alteration been found to have taken place. Nor have other virulent examples of S. pyogenes obtained from non-scarlatinal sources been found to undergo appreciable change in their morphological or cultural characters as the result of passage through a mouse. The morphological and cultural characters of S. pyogenes, therefore, appear to be also fixed.

In some instances of Streptococcus scarlatinæ then their distinction from Streptococcus pyogenes seems to be permanent. In other instances, however, S. scarlatinæ loses some of its differential characters as the result of passage through a mouse. It was mentioned in my last report that on one occasion where such modification had been produced by passage through a mouse, still further loss of differential characters resulted on the organism being passed through a guinea-pig, and it was only in one or two special points that the streptococcus recovered from the guinea-pig could be distinguished from Streptococcus pyogenes.

Recalling once more the results of the bacteriological examination of the scarlatinal cadaver, it will be recollected that in five of the ten cases examined after death from scarlatina the streptococcus obtained from the blood and organs (and in one case from the secretion on the surface of the tonsil as well) was identical in morphological and cultural respects with the streptococcus just mentioned as being obtained from the guinea-pig. It was in fact only by dint of the same special points that a difference from streptococcus pyogenes could be detected. These were with regard to conglomeration in broth culture, lace-work in agar condensation fluid, and bacillus formation both in the latter medium and also in the agar colonies. All three characters were more extensive in the

case of the streptococcus from the guinea-pig and in that from the scarlatinal cadaver than in examples of Streptococcus pyogenes with which comparison had been up to that time made.

But, although the streptococcus present in five fatal cases of scarlatina coincided with the specimen of S. scarlatinæ that had been modified by passage first through a mouse and then through a guinea-pig, and although this streptococcus showed the same points of variance with pyogenes as did the streptococcus obtained from the guinea-pig, I was, nevertheless, unable to definitely identify it with Streptococcus scarlatinæ. The reason why no final decision in the matter could be arrived at was the circumstance that, in other respects than in the special points mentioned, there was nothing to distinguish these two streptococci (from the guinea-pig and from the scarlatinal cadaver respectively) from Streptococcus pyogenes, and also because in these very points the difference was in the case of some specimens of pyogenes only a matter of degree.

It was desirable, therefore, to collect further specimens of Streptococcus pyogenes, and to see whether any exceptional instances of that organism occur in which conglomeration in broth culture, lace-work in agar condensation fluid, and bacillus formation both in the latter and in agar colonies occur as extensively as in the case of the streptococcus recovered on five occasions from the scarlatinal cadaver, and on one occasion from the guinea-pig that had been inoculated with the mouse Streptococcus scarlatinæ.

Accordingly, during the past year I have continued to examine examples of Streptococcus pyogenes, and especially in these three respects. Among the examples of pyogenes that were scrutinised, three, owing to the circumstances in which they were found, were specially suited for this purpose of comparison. The first of them was kindly given me by Dr. Andrewes. It was obtained in pure culture from the heart's blood of a patient who had succumbed to a non-scarlatinal septicæmic infection originating from the region of the larynx. From the mucous membrane of the latter organ a suppurating sinus extended to the cricoid cartilage which had become necrosed. Adhesive pericarditis was found post-mortem, and there were infarcts in the spleen. The patient, an adult woman, had also suffered from acute parenchymatous nephritis. The streptococcus present in the heart's blood, and which had doubtless directly contributed to the fatal result, had presumably spread from the mucous membrane of the larynx. As scarlatina was clinically excluded, this was a good instance of a fatal streptococcic invasion in a non-scarlatinal case, starting, moreover, from the neighbourhood of the region to which is traced the fatal streptococcic invasion that occurs in scarlatina.

The streptococcus obtained from the heart's blood of this patient had the following characters :—

Broth, 1 day, 37° C.—The fluid remains clear. Growth occurs at the foot of the tube in the form of small white masses and flocculi. Microscopical examination shows that the organism is a streptococcus, which though not coherent, nevertheless exhibits conspicuous conglomeration, equalling in this respect the streptococcus most frequently obtained from the scarlatinal cadaver.

Agar condensation fluid, 2 *days*, 37° C.—Lace-work is present, and is as extensive as in the case of the streptococcus from the scarlatinal cadaver. The majority of the individuals are cocci, but distinctly bacillary forms occur.

Serum condensation fluid, 1 *day*, 37° C.—Chains of medium length composed entirely of coccus-shaped individuals are seen.

Litmus milk, 37° C.—A slightly acid reaction is produced in the course of 48 hours. In 10 days the acidity is increased, but is not "strong," and there is no clotting.

Agar colonies, 1 *day*, 37° C.—The growth is microscopically indistinguishable from that of the streptococcus of the scarlatinal cadaver. The latter, as was mentioned in my last report, is microscopically indistinguishable on agar from the usual form of S. pyogenes. Microscopically, while the majority of the individuals are cocus-shaped, several bacillary form are seen.

Serum growth, 1 *day*, 37° C.—Indistinguishable from the streptococcus of the scarlatinal cadaver and from S. pyogenes.

Gelatine growth, 20° C.—Both macroscopically (Fig. 35, Plate XV., Tube III.) and microscopically indistinguishable from the growth either of the streptococcus of the scarlatinal cadaver, or of S. pyogenes. No spindles or bacillary forms are seen in impression preparations made on the tenth day.

Pathogenicity.—A mouse injected with this streptococcus was dead on the fifth day. Post-mortem examination showed congestion of the organs, enlargement of the spleen, and pus at the site of inoculation. The streptococcus was recovered from the pus, heart's blood, spleen, kidney, and liver, and its morphological and cultural characters were re-examined. They were found to be unaltered.

Summary.—With regard to conglomeration in broth culture, lace-work in agar condensation fluid, and bacillus formation both in the last medium and also in the agar colonies, therefore, I was unable to distinguish this streptococcus from the streptococcus obtained from the blood and organs in five cases after death from scarlatina. In other respects both micro-organisms were indistinguishable from the usual type of Streptococcus pyogenes.

The two other cases specially suited for the purpose of comparison were both instances of the pneumonic form of oriental or bubonic plague. I am indebted to Dr. Klein for the opportunity of examining the material from them sent to him for the purpose of diagnosis, and I have also to thank Dr. Darra Mair for the following clinical particulars :—

A. S., aged 28. and R. C. L., aged 30, were both reported ill on January 12th at midnight, with symptoms of headache, and pains in the back of the neck and in some of the joints. The lungs of L. were examined on January 15th, when many râles and bronchial breathing were heard, especially over the right lung. A. S. died at 1.30 p.m. on January 15th; and L. died at 5.30 a.m. on January 16th. The duration of the illness of A. S., therefore, was about 2½ days, and of R. C. L. about 3¼ days. Post-mortem, the lungs of both

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patients showed consolidation, and were found to be crammed with B. pestis. From the spleen of both cases, while B. pestis was present in the majority, a streptococcus was also isolated. A section of the spleen of R. C. L., stained with Gram's method, is seen in Fig. 32, Plate XIV. In this specimen the plague bacilli, which are in the majority in most parts of the section, have been decolourised and do not show in the photograph; but the streptococci, which retain the stain, are here seen *in sitû* forming groups in the splenic tissue.

The streptococcus isolated from the spleen of each case was examined in detail. That obtained from the spleen of R. C. L. was indistinguishable in broth from the streptococcus of the scarlatinal cadaver—conglomeration being conspicuous. In agar condensation fluid lace-work was extensive, and several bacillary forms were also seen. Some of the agar colonies showed bacillary forms. In other morphological and cultural respects (Fig. 35, Plate XV., Tube II.) the streptococcus was indistinguishable either from the streptococcus of the scarlatinal cadaver or from the usual type of Streptococcus pyogenes. A mouse inoculated with it showed local suppuration and was dead in 14 days. Post-mortem, the organs were congested and the spleen enlarged. The streptococcus was recovered from the spleen of the mouse and re-examined in morphological and cultural respects. It was found to be exactly the same as before.

Summary.—The streptococcus that had penetrated to the spleen in this case (R.C.L.) of pneumonic plague, therefore, was indistinguishable from the streptococcus obtained from the blood and organs in five fatal cases of scarlatina.

The streptococcus from the spleen of A. S. was similar to that obtained from the other case, except that broth was rendered turbid; lace-work in agar condensation fluid, though present, was rather less extensive; and no bacillary forms were seen either in the latter or in the agar colonies. The conglomeration shown in microscopical preparations of the broth culture, however, was as conspicuous as in the case of the streptococcus obtained from the scarlatinal cadaver. A mouse inoculated with this streptococcus died on the ninth day with congested organs and an enlarged spleen. The organism was recovered from the spleen and found to be unaltered in morphological and cultural respects.

Summary.—The streptococcus that had penetrated to the spleen of this second case of pneumonic plague was not distinguishable from the streptococcus obtained in five cases from the scarlatinal cadaver.

The result of the further comparative study of streptococcus pyogenes, therefore, has been that a streptococcus isolated from the heart's blood of a case of septicæmia, originating in disease of the larynx and clinically distinct from scarlatina, and likewise a streptococcus isolated from the spleen of pneumonic plague, have both been found to be indistinguishable from the streptococcus obtained from the blood and organs in five cases after death from scarlatina, and described in my last year's report. This streptococcus, then, is not limited to scarlatina, but may occur in

non-scarlatinal conditions. In the case of pneumonic plague, where B. pestis was in an overwhelming majority in the lung, and in the majority in the spleen (though not here so overwhelmingly as in the lung), this streptococcus clearly formed a secondary or subsidiary invasion. The time that elapsed between the onset of plague and the death of the patient was only a little over three days. The secondary invasion, therefore, was a rapid affair.

The conclusion to which these further control-observations have led me is, that the streptococcus described in my last year's report as having been obtained from the blood and organs in five out of the ten cases examined after death from scarlatina, is only an unusual form of Streptococcus pyogenes, and not, as I was inclined to think, a modified form of streptococcus scarlatinæ. I believe also that its *rôle* in scarlatina is, as in the cases of pneumonic plague examined, subsidiary or secondary to that of the micro-organism to which the disease of the patient must be primarily attributed.

SECTION VII.

General Conclusions.

The further experience described in the present report leads to the conclusion that an important part is sometimes played in scarlatina by a streptococcus which I have been unable to distinguish from examples of Streptococcus pyogenes. The evidence dealing with the occurrence of this organism in scarlatina may be summarised as follows :—

1. Streptococcus pyogenes may be present in the secretion on the surface of the tonsil in a case of clinically mild, uncomplicated scarlatina.

2. It may be present there in an early stage of the disease. S. pyogenes was in fact found in three of the earliest cases examined, viz. : on the second, third, and fourth day from the onset of the scarlatina.

3. So far as the observations yet made go, it would seem that, when present, streptococcus pyogenes may be as abundant in the secretion on the surface of the tonsil as Streptococcus scarlatinæ. For instance, in the case examined on the second day of scarlatina, both organisms were present to the extent of at least 250,000 per cc. of the tonsillar secretion.

4. In the nasal discharge of scarlatina, S. pyogenes was found in five out of 12 cases examined (Report of the Medical Officer, Local Government Board, 1898–99, p. 489).

5. In the aural discharge of scarlatina, S. pyogenes was found in five out of 12 cases previously reported on (*ib.*, p. 487), and in four out of seven cases described in the present

report. S. pyogenes has, therefore, been found in altogether nine out of 19 cases. It should be added that S. pyogenes may be present on the first day of the aural discharge.

6. In five out of 10 cases examined *after death* from scarlatina, and described in detail in my last year's report, the streptococcus present in the blood and organs has been now found to be indistinguishable from certain examples of Streptococcus pyogenes. In one of these five cases examined *after death* from scarlatina, the secretion on the surface of the tonsil yielded the same streptococcus, namely pyogenes, but not Streptococcus scarlatinæ.

Streptococcus pyogenes, therefore, may play a very prominent part in scarlatina. In the earliest stages of the disease it may be present, together with Streptococcus scarlatinæ, in the secretion on the surface of the tonsil. In both the nasal and in the aural discharge it is a good deal more frequently met with than is Streptococcus scarlatinæ. Finally, in some cases, Streptococcus pyogenes invades the blood and organs and so appears to be directly responsible for the death of the patient.

But, important though the part of Streptococcus pyogenes in scarlatina may be, there is reason to believe that the part of Streptococcus scarlatinæ is still more important. The streptococcic invasion, to which the death of the patient was found to be most often due, was traced in my last year's report to the secretion on the surface of the tonsil. The study of the tonsillar secretion in scarlatina that has been made during the past year has shown that, while S. pyogenes was found in this secretion in three out of ten cases examined, S. scarlatinæ was present in *all ten* cases, and that in seven this micro-organism grew in pure culture in serum tubes inoculated with similar or even greater amounts of tonsillar secretion.

The presence of Streptococcus scarlatinæ in the throats of two cases of suspected scarlatina that showed desquamation is as suggestive as is its absence in two other cases that showed no desquamation. The occurrence of streptococci bearing a morphological and cultural resemblance to S. scarlatinæ, together with B. diphtheriæ, in serum cultures made from the tonsillar secretion during an attack of diphtheria, is a matter that requires further investigation. In the case of the virulent examples of these streptococci, however, it will be noticed that the mouse succumbed in a shorter time than it usually does when inoculated with Streptococcus scarlatinæ.

The quantitative observations included in the present report show that the *abundance* of B. diphtheriæ in the tonsillar mucus in diphtheria is paralleled by S. scarlatinæ in scarlatina. But while Streptococcus scarlatinæ is such a constant and suggestive feature of the tonsillar mucus in scarlatina, it appears to be comparatively rare in the nasal and aural discharges. It has been detected in only two out of twelve nasal discharges, and in only one out of nineteen aural discharges examined up to the present time.

In only two out of ten cases examined *after death* from scarlatina was a streptococcus admitting of immediate identification with Streptococcus scarlatinæ present. In three other of the ten cases, however, the streptococcus obtained from the blood and internal organs, although not clotting milk and not producing a strong acid reaction, was eventually identified with S. scarlatinæ chiefly on the ground of the extent to which it exhibited spindle and bacillary forms when growing in various media. For a similar reason the streptococcus described and figured in my last year's report as being obtained from a pleural effusion during the life of the patient was eventually identified with S. scarlatinæ.

The further experiments that have been made in passing examples of definite Streptococcus scarlatinæ through mice have brought out three main points concerning this organism. *First*, when recovered from the mouse, it was found in five out of eight cases to have lost none of its cultural and morphological individuality. In these five instances, therefore, it was, on recovery from this animal, as utterly distinct from Streptococcus pyogenes as originally. *Secondly*, its virulence for the mouse was in several cases also unaltered when the organism was recovered from a mouse that had succumbed to it. *Thirdly*, it appears to be capable of producing a general disease in both mouse and guinea-pig, attended with a fatal ending, while itself remaining restricted to the site at which it was inoculated.

These three determinations go a long way towards establishing Streptococcus scarlatinæ as a specific pathogenic micro-organism.

The fact that Streptococcus scarlatinæ *can* produce a fatal effect on its host while confined to the neighbourhood of the site of inoculation suggests an explanation of those exceptionally rapidly fatal so-called "Toxic" cases of scarlatina which are on record, and as regards which bacteriological examination after death failed to reveal any micro-organisms either in the blood or in the internal organs of the patient.

In cases of scarlatina, however, less immediately fatal, Streptococcus pyogenes appears to often quite outstrip Streptococcus scarlatinæ. So eclipsed may the latter organism be in these cases that after death the blood and organs may give pure cultures of S. pyogenes, and even the secretion on the surface of the tonsil, while readily yielding S. pyogenes, may fail to give S. scarlatinæ. It is quite possible that in such cases as these the growth of S. pyogenes has led to the suppression of the original cause of the disease, viz., S. scarlatinæ.

In conclusion I would point out that the characters of Streptococcus scarlatinæ seem to imply that it occupies a position in the bacteriological kingdom between Streptococcus pyogenes and Bacillus diphtheriæ. Accordingly the question arises as to whether it would not be more accurate to term the micro-organism a bacillus than a streptococcus. From the study of the streptococcus group that I have made during the last three years, however, I have formed the opinion that when the characters and relations of S. scarlatinæ are more generally and completely understood,

APP. B, No. 3.

On the Bacteriology of Scarlatina; by Dr. Gordon.

it will still be included in the *genus* Streptococcus, and for this reason I have continued to regard it rather as a peculiar streptococcus than as a true bacillus. But while continuing for the present to regard S. scarlatinæ as a member of the *genus* Streptococcus, I believe that the differences observed between this micro-organism and Streptococcus pyogenes signify difference of species.

Photographs by Mr. Albert Norman, illustrating the morphology of streptococcus scarlatinæ, and comparing it under the same conditions with that of B. diphtheriæ and of streptococcus pyogenes, are seen in Plates IX. and X.

No. 4.

REPORT on INOCULATION of SOIL with SEWAGE; by Dr. A. C. HOUSTON.

APP. B, No. 4.
On the Inoculation of Soil with Sewage by Dr. Houston.

The main object of these experiments was to ascertain whether in the surface layers of soil after it had been inoculated with sewage, certain microbes peculiar to sewage, or which are at all events characteristic of sewage in the sense of being specially abundant therein, retained their vitality for any considerable length of time. In brief, it was sought to determine the ultimate fate of such sewage microbes as B. coli, streptococci, and spores of B. enteritidis sporogenes, when sown broadcast on soil.

In a previous report it was pointed out that the difficulties attending the isolation of the typhoid fever bacillus from unsterilised soil, even after its addition thereto in gross amount, were of an almost insuperable character. And it was suggested that as the typhoid bacillus is practically always associated with other intestinal microbes much more easily isolated and identified, search in soil for these more readily identifiable bacteria might indirectly be of service in giving information of the probable fate therein of their sometime associate, namely, the pathogenic enteric fever bacillus.

It will be generally admitted that sewage is apt to be concerned in the dissemination of typhoid fever, and it is well known that sewage contains B. coli (and allied forms) in great abundance.* Now, B. coli is most certainly a more hardy germ than B. typhosus; that is, more hardy under all the conditions to which it is possible to subject these bacteria in the laboratory. Of course it is conceivable that in nature conditions may arise which are more favourable to the typhoid bacillus than B. coli. But at present all the available evidence points to the improbability of B. typhosus surviving under conditions destructive to the vitality of B. coli. It is evident then that if it could be proved that B. coli perished in soil, the presumption in favour of the death also of the typhoid bacillus would be of a strong kind. A similar inference might reasonably be drawn as regards the fate of the cholera vibrio,† and

* For example, as regards Crossness and Barking crude sewage I obtained per cc. B. coli in the following amounts:—

Crossness crude sewage, 38 samples—	Barking crude sewage, 10 samples—
In 3 samples, less than 100,000.	In 2 samples, more than 1,000,000.
In 6 samples, 1,000,000 or more.	In 8 samples, 100,000 but less than 1,000,000.
In 29 samples, at least 100,000 but less than 1,000,000.	

† The cholera vibrio is seemingly less resistant than B. typhosus.

possibly other non-sporing microbes of pathogenic sort. It is known that sewage specifically contaminated with the excreta of enteric fever or of cholera patients can, when gaining entrance into a water supply, give rise to typhoid fever and cholera, and it seems reasonable to conjecture that other diseases may be spread by means of sewage polluted waters.

An enquiry, therefore, which seeks to trace the ultimate fate of sewage microbes, when sewage is artificially added in large amount to a soil, must be regarded as one likely not only to yield direct information of a useful kind, but indirectly to give indications as to the probability or possibility of human disease germs maintaining their existence saprophytically under parallel conditions.*

Already I have furnished some information bearing more or less directly on this subject. Thus, in previous reports I have pointed out that soils obtained from diverse sources all contain a very large number of spores of bacteria (both actually and relatively to the total bacterial flora); and I have even ventured to adduce this fact, tentatively, as basis for belief that soil is unfavourable to the vitality of non-sporing bacteria, particularly those of pathogenic sort. On the other hand, although the number of bacteria present as spores in soil is very great many non-sporing microbes (*e.g.*, the fluorescent bacilli) are commonly, if not habitually, present also in soil. And it may well be the case that although the general tendency of non-sporing bacteria is to perish in soil, the different races of these microbes escape total extermination because (perhaps at the period of lowest ebb in their life history) some favourable condition supervenes, allowing of a recrudescence of their vitality and the growth of abundant progeny. Thus, it may be conjectured that bright sunshine and dry winds rapidly diminish the number of non-sporing microbes in soils at or near the surface; but that previous to their total extermination a supervening period of damp and warm weather, with absence of sunshine, allows the living germs still persisting to reproduce their kind and to reassert their vitality. But however true this may be as regards certain non-sporing microbes which normally exist under saprophytic conditions, and which are not very particular as regards their nourishment, it may be remote from the truth as regards other and like germs, particularly those of pathogenic sort. Thus, I have shown that although B. prodigiosus survived 158 days in soil ("in rure"), the exotic cholera vibrio seemingly perished in the same soil and under parallel conditions in a few days.

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* Obviously this investigation has a bearing on the Chichester inquiry, which is also dealt with in this volume. It may be said to possess as well some interest in connexion with the theory now so prevalent that dust storms are largely instrumental in spreading enteric fever in tropical climates. This theory seemingly rests on the assumption that B. typhosus multiplies in specifically contaminated soils, can maintain its vitality in dry soil, and that dust storms can carry the living contagion from place to place, and so infect individuals either directly or indirectly through the medium of articles of food and drink. This is not the place to offer any criticisms, but the facts revealed in this report as regards B. coli have some bearing on the question.

Again, although B. coli is present in extraordinary numbers in excremental matters, and notwithstanding that these substances have a wide distribution in nature, I have found B. coli to be *relatively** absent from surface soils other than those *recently* contaminated with substances of intestinal origin. This would seem to afford reasonable ground for believing in the final extinction of pathogenic non-sporing germs, as for example the typhoid bacillus, in the case of soils specifically contaminated.†

The microbes to which, as has been said, special attention was directed during the progress of this enquiry were Streptococci, B. coli (and closely allied forms) and B. enteritidis sporogenes.

So far as could be judged from my previous observations (soil and water reports), the presence of streptococci points to extremely recent contamination with matters of intestinal outcome, and the presence of B. coli to animal pollution of comparatively recent sort. As regards the spores of B. enteritidis sporogenes, their presence does not necessarily imply pollution of recent date.

It was therefore to be anticipated that in the case of soils artificially contaminated with sewage the streptococci would rapidly disappear; that later, B. coli would no longer be capable of demonstration; but that the spores of B. enteritidis sporogenes would persist as a more or less permanent record of pollution having taken place.

The following is a summary of the several sections of the report on my proceedings that I now have to make:—

A. Description of the bacteriological methods adopted in the investigation.

B. Part I., Series 1, 2 and 3: Inoculation of soil "in rure" with cesspool sewage.

C. Part II., Series A: Inoculation of soil "in urbe" with London crude sewage.

[The arrangement of the various tables and diagrams will be found to be as follows: The tables are brought into the text in appropriate order, with the exception of the table of meteorological observations, which is placed at the end of the report. Diagram 1 will be found at the end of Part I., Series 1; diagram 2 at the end of Part I., Series 2; diagram 3 at the end of Part I., Series 3; and diagram 4 at the end of Part II., Series A.]

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* I have endeavoured in previous reports to be careful to speak only of the *relative* absence of B. coli, or of its absence from a substance when using for test a definite quantity and under specified conditions of experiment. Complete or total absence of B. coli is another matter, and one concerning which it is wise to speak with reserve.

† I am speaking here of the *surface* layers of soil. As regards the deeper layers of soil, the conditions may be altogether different.

A. Bacteriological Methods adopted in the Investigation.

The following is a brief account of the methods used throughout the investigation :—

Collection of samples.—The samples of soil were collected in sterile tins. A sterile tin scoop was used to transfer the surface layers of the soil to the tins.

Dilution of the samples.—The samples of soil were diluted with sterile water as follows: To each of six small conical flasks (labelled in sequence (1), (2), (3), (4), (5), (6)), 90 cc. of distilled water were added. The flasks were plugged with cotton wool and sterilised in the usual way. Ten grammes of the soil were weighed out into a sterile watch glass and transferred from the watch glass with a suitable sterile instrument into flask (1). A sterilised glass rod with a flattened end was used to bruise and intimately mix the soil and water. After allowing five minutes to elapse, so as to allow the grosser particles to settle, 10 cc. of the surface liquid were withdrawn by means of a sterilised pipette and added to the second flask (2). After shaking, 10 cc. of (2) were withdrawn by means of a sterile pipette and added to the third flask (3). In the same manner the fourth flask (4) was inoculated from flask (3), the fifth flask (5) from flask (4), and finally the sixth flask (6) from flask (5).

Total number of bacteria (gelatine at 20° C.).—The number of bacteria was estimated in Series 1 and 2, but not in Series 3 or in Series A., Part II. Gelatine plate cultures were made in the usual way, and commonly 1 cc. respectively of (3), (4) and (5) dilutions were used. Sometimes plates were made from the (2) and (6) dilutions as well.

Spores of aërobic bacteria (gelatine at 20° C.).—The number of spores of bacteria was estimated in Series 1 and 2 but not in Series 3. A series of 10 cc. gelatine tubes were inoculated, usually with 1 cc. of (3), (4) and (5) dilutions. These were heated to 80° C. for ten minutes and plate cultures made.

"*Gas*" *in gelatine* "*shake*" *cultures* (24 hours at 20° C.).—10 cc. gelatine tubes were inoculated with 1 cc. from the different dilutions. The tubes were placed in warm water (about 40° C.) for a few minutes, shaken, placed in cold water until the gelatine had become solid again, and then incubated at 20° C. In 24 hours they were examined for "gas" production. Gas-forming bacteria are peculiarly abundant in sewage, and they belong chiefly to the B. coli and B. proteus class. $\frac{1}{100}$ to $\frac{1}{1000}$ cc. of crude sewage is almost invariably sufficient to produce "gas" in gelatine "shake" cultures in 24 hours at 20° C. Virgin soils and pure waters usually yield negative results with this test, even when comparatively large quantities of these substances are used. It was hoped that this "gas" test might yield useful results in the present investigation.

Indol curve.—In Series 3, Part I., and Series A, Part II., an attempt was made to trace the decline in the number of putrefactive bacteria by observing the smallest amount of soil capable of producing indol in broth cultures, after five days' incubation at 37° C. The production of indol is a conspicuous property of B. coli, but there are other microbes which also possess this ability.* Without laying too much stress on the value of this test, I think it may be regarded as a useful index of the relative abundance of putrefactive bacteria, probably of intestinal outcome, and not improbably belonging to the coli species.† The

* For example, some of the bacteria present in soil in the form of spores can produce indol.

† On 15th June, 1898, a determination was made of the smallest amount of Crossness crude sewage, and of the effluents from the 4-ft. coke-bed at Crossness, capable of producing indol in broth cultures. In both cases indol was produced with so minute a quantity as $\frac{1}{1000000}$ of a cc., but not with $\frac{1}{10000000}$ cc. Incidentally it is of interest to compare this result with that observed with potable waters. In *some* water samples I have obtained a negative result even when using for cultivation purposes the bacterial contents of so much as 100 cc. This, no doubt, is exceptional, but it serves to emphasize the remarkable biological distinction as regards indol production which may exist between some drinking waters and crude sewage.

determinations were made as follows :—A series of broth tubes were inoculated severally with (as a rule) 1 cc. of (2), (3), (4), and (5) dilutions of the soil. The tubes were incubated at 37° C. for five days, and then tested for indol.

Spores of B. enteritidis sporogenes (Klein).—A series of sterile milk tubes were inoculated severally with 1 cc. of (2), (3), (4), and (5) dilutions of the soil. These were heated to 80° C. for ten minutes, and cultivated under anaërobic conditions at a temperature of 37° C. In this part of the work great practical difficulties were encountered, and the results are in a measure inconclusive. The soil chosen for the investigations was already rich in the spores of this pathogenic microbe, and the addition of the sewage, even in large amount, was not accompanied, as had been anticipated, by a large increase in their number. While still adhering to the view that the spores of B. enteritidis sporogenes persist in the soil as a record of past pollution, I must confess that my results in this direction are not easy of interpretation.

B. coli (and closely allied forms).—Two methods were used in this connexion, either separately or in conjunction; viz., surface phenol (0·05 per cent.) gelatine plate cultures and phenol (0·05 per cent.) broth cultures. In the latter case, surface phenol gelatine plates were made from the broth after 25–48 hours incubation at 37° C. In both cases the colonies appearing in the plate cultures, which bore a resemblance to B. coli, were subcultured in broth (diffuse cloudiness and indol formation), in litmus-milk (acidity and clotting), and in gelatine ("shake" cultures for "gas" formation). Usually the phenol gelatine plates were made from (2), (3), and (4) dilutions, 0·1 cc. being used in each case. As regards the broth cultures, 1 cc. of dilutions (2), (3), (4), and (5) was commonly employed.

Streptococci.—Surface agar plate cultures were used. These were usually inoculated with 0·1 cc. of dilutions (2), (3), and (4), and incubated at 37° C. for 24–48 hours. Minute colonies resembling streptococci were subcultured in broth for further examination, and incubated at 37° C. If on microscopic examination of these broth cultures the growth appeared to be that of a streptococcus, the microbe was studied in agar, gelatine, and milk cultures.

B. PART I.—(SERIES 1, 2 and 3.)

Inoculation of soil "in rure" with cesspool sewage.

The plot of ground chosen for the experiments is situated about twelve miles from London, on a gentleman's private estate.*

The soil was originally dredged (about twelve years ago) from the bed of a stream and deposited on marshy ground adjoining this stream. Although at one time believed to to have been manured, no manure or other "dressing" had been applied to it for at least six years. The plot of ground is sheltered to some extent by adjacent trees and shrubs from the effects of the wind, and during certain hours of the day from the direct rays of the sun. The soil may be regarded as of rather poor quality and not rich in organic matter. As the plot of ground had a gentle slope in a uniform direction, it was thought advisable to level it. This was done with great care and, as far as possible, in such a way as to leave the different layers of soil in their original relative positions. Previous to the experiments the plot had been grown with comfrey plants. These had been cut for fodder, and only the roots remained. During the levelling operations the roots were removed.

* I am greatly indebted to Mr. Smee for placing his land at my disposal for the above experiments.

An area was marked out with pegs and stout string, measuring 5′ × 5′. This area was further subdivided into sixteen equal divisions (15″ × 15″). The dimensions, &c. of the plot are shewn in diagram 1, page 425.

Previous to the inoculation of the soil with cesspool sewage a sample of soil was collected (July 6, 1900) and examined bacteriologically. The results are given, along with other facts, in the tables dealing with the examination of the soil subsequent to inoculation; but here it may be stated that no B. coli or streptococci were found, and that no "gas" was observed in the gelatine "shake" cultures, except in the 0·01 gramme culture where two minute bubbles of gas were observed. But as regards the total number of bacteria, number of spores of aerobic bacteria and number of spores of B. enteritidis sporogenes, the results were higher than had been anticipated. The figures were 9,300,000; 1,800,000; and 1,000 (but not 10,000), respectively, per gramme. In the light of the results of the examination of the samples of soil subsequent to inoculation, I am inclined to conjecture that the above figures were probably in excess of the average bacterial contents of the particular soil previous to its artificial pollution.

Series 1.

On July 9th, 1900, the whole of the plot was watered equally all over with twelve gallons (about 54,500 cc.) of cesspool sewage.* The biological composition of this sewage is given in the tables relating to the results of the examination of the samples of soil. Here it may be stated that B. coli,† typical in all respects, was isolated from $\frac{1}{10000}$ and $\frac{1}{1000}$ of a cc. and streptococci‡ from $\frac{1}{1000}$ cc. of the sewage. The number of spores of B. enteritidis sporogenes was at least 100 but less than 1,000 per cc. As regards the "gas" test, $\frac{1}{100}$ but not $\frac{1}{1000}$ cc. yielded gas in gelatine "shake" cultures in 24 hours at 20° C. The total number of bacteria and spores of aërobic bacteria was 1,970,000 and 160 respectively per cc. It may be said, then, that, calculated from the above figures, the inoculation of the soil with twelve gallons of cesspool sewage meant the addition to the soil of about 107 thousand million bacteria; inclusive of 545 million B. coli (typical in all respects) eight million spores of aërobic bacteria, at least five million spores of B. enteritidis sporogenes, 54 million streptococci, and a multitude of gas-forming bacteria.

Immediately after the application of the sewage (July 9th), sample 1 was collected, and further samples were collected on the following dates: July 11th, 16th, 23rd, 26th, and on August 2nd.§

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* Represents the slop water and excremental matters from a household of four to six persons.

† *See* microbes 1 and 2, Table V.

‡ *See* microbes A, B and C, Table VII.

§ *See* diagram 1.

The following is a brief account of the results of the examination of the various samples of soil :—

Total NUMBER of bacteria, inclusive of spores, (gelatine at 20° C.), and *Number of SPORES of aërobic bacteria* (gelatine at 20° C. after preliminary heating to 80° C. for ten minutes).

It is convenient to consider these results together. (Table I.)

TABLE I.

Showing as regards (1) TOTAL NUMBER of Bacteria, and (2) Number of SPORES of Aërobic Bacteria, the results of the Bacteriological Examination of Soils A; 1, 2, 3, 4, 5, 6; and of a sample of cesspool sewage.

[Part I., Series 1.]

Description of the Sample.	Total Number of Bacteria per gramme of Soil.	Number of Spores of Aërobic Bacteria per gramme of Soil.	Ratio of Total Number of Bacteria to Spores.
Soil A. Collected before the inoculation of the soil, July 6th, 1900.	9,300,000	1,800,000	5 : 1
Cesspool sewage, July 9th, 1900	1,970,000 in 1 cc.	160 in 1 cc	12,312 : 1
Soil 1. Collected immediately after the inoculation of the plot, July 9th, 1900.	3,800,000	650,000	5·8 : 1
Soil 2. Collected 2 days after the inoculation, July 11th, 1900.	12,400,000	1,960,000.	6 : 1.
Soil 3. Collected 7 days after the inoculation, July 16th, 1900.	840,000	440,000	1·9 : 1
Soil 4. Collected 14 days after the inoculation, July 23rd, 1900.	620,000	240,000	2·5 : 1
Soil 5. Collected 17 days after the inoculation, July 26th, 1900.	470,000	270,000	1·7 : 1
Soil 6. Collected 24 days after the inoculation, August 2nd, 1900.	1,840,000	750,000	2·4 : 1

These results are not devoid of interest. Soil A contained more bacteria than had been anticipated, and possibly (perhaps probably in the light of later results) this particular sample of soil chosen for the control experiment may have been specially rich in organic matter and bacteria, and may not have been really representative

App. B. No. 4. … by Dr. …

of the soil in general covering the plot of ground. It is of considerable interest to contrast the number of spores and ratio of spores to the total bacteria in this sample of soil and in the cesspool sewage. In Soil A the figures were 1,800,000 spores and 9,300,000 bacteria (ratio 1 : 5). In the cesspool sewage the results were 160 spores and 1,970,000 bacteria (ratio 1 : 12,312).* It is curious that Soil 1, collected immediately after the inoculation, contained fewer bacteria than Soil A. Possibly this may have been due to the soil being wet in the case of Soil 1 and comparatively dry in the case of Soil A: which means that there would be less soil *as soil* weighed out in Soil 1 as compared with Soil A. Soil 2 showed a definite increase, over twelve million bacteria per gramme.† Soils 3, 4, 5 showed in successive stages a marked decrease, probably due to the great heat and dryness prevailing during that period. It may be worthy of note that in these soils, although the actual number of spores showed a diminution, the ratio of spores to the total bacterial flora was somewhat increased. The inference would seem to be that the conditions were so unfavourable as either to destroy the bacillary forms much more rapidly than the spores, or else that some of the microbes capable of forming spores and previously present as bacilli formed spores under the adverse conditions to escape extinction. Soil 6 showed a rise in the number of bacteria and spores, probably due to the rain falling between July 26th and August 2nd.

As regards the sorts of bacteria met with in the cultivations, the *granular* bacillus and fluorescent (liquefying and non-liquefying) bacteria were usually very numerous. The fluorescent bacteria seemed to be specially numerous in the soils containing the most moisture. The total number of B. mycoides per gramme in all the soils was at least 10,000 but less than 100,000, except in the case of Soil 4, where the number was at least 1,000 but less than 10,000. As regards the spores of B. mycoides, the records were approximately similar, except that in Soils 2, 3, and 6 the numbers were at least twenty times less, one-half less, and nearly one-half less respectively. As it seemed to me, B. proteus was specially abundant in the soils collected soon after the inoculation of the plot with the sewage.‡

Neither in this series of experiments nor in succeeding series was there any indication that the addition of the sewage microbes led to a "crowding out" of the original soil bacteria. On the contrary, the soil bacteria seemed rather to gain the mastery and to oust many of the invading sewage germs.

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* In previous reports I have drawn attention to the remarkable distinction between sewage and waters on the one hand and soils on the other in this respect.

† It must be remembered that the difficulty of arriving at satisfactory conclusions was increased by the fact that not only were sewage microbes added to the soil, but liquid pabulum as well. This large addition of assimilable organic matter would naturally lead to a preliminary multiplication of the bacteria already present in the soil, apart from the question of the fate of the accompanying sewage microbes.

‡ This report may be open to the charge of too profuse statement of details. But the results are given in full without any reservation so that anyone disposed to do so may form their own conclusions.

"*GAS*" *in gelatine* "*shake*" *cultures* (24 hours at 20° C.). The results obtained by the use of this test are shewn in Table II.

TABLE II.

Showing as regards "GAS" in gelatine "shake" cultures (24 hrs. at 20° C.) the results of the Bacteriological Examination of Soils A; 1, 2, 3, 4, 5, 6; and of a sample of cesspool sewage.

[Part I., Series 1.]

Description of the Sample.	"Gas" in Gelatine "Shake" Cultures (24 hours at 20° C.) inoculated with		
	0·01 gramme.	0·001 gramme.	0·0001 gramme.
Soil A. Collected before the inoculation of the soil, July 6th, 1900.	+ (but only two minute bubbles).	-	-
Cesspool sewage, July 9th, 1900	+ 0·01 cc.	- 0·001 cc.	- 0·0001 cc.
Soil 1. Collected immediately after the inoculation of the plot, July 9th, 1900.	..	-	-
Soil 2. Collected 2 days after the inoculation, July 11th, 1900.	+	+	+
Soil 3. Collected 7 days after the inoculation, July 16th, 1900.	-	-	-
Soil 4. Collected 14 days after the inoculation, July 23rd, 1900.	-	-	-
Soil 5. Collected 17 days after the inoculation, July 26th, 1900.	-	-	-
Soil 6. Collected 24 days after the inoculation, August 2nd, 1900.	-	-	-

It is to be noted that Soil A gave a negative result with $\frac{1}{1000}$ gramme, and a barely positive result with $\frac{1}{100}$ gramme. The cesspool sewage gave a positive result with $\frac{1}{100}$ cc. but not with $\frac{1}{1000}$ cc. Soil 1, contrary to expectation, gave a negative result with $\frac{1}{1000}$ gramme. Possibly a positive result might have been obtained with $\frac{1}{100}$ gramme, but no culture was made with this amount, as it was anticipated that the soil would have been far richer in microbial life than actually turned out to be the case. Soil 2, however, gave a positive result, even with $\frac{1}{10000}$ gramme, and it may be surmised that an immediate multiplication of the gas-forming bacteria had taken place in the soil as a result of its artificial pollution. Soils 3, 4, 5, 6 yielded negative results with $\frac{1}{100}$ gramme. Soil 3 was collected only five days after Soil 2, so

it seems certain that the destruction of the gas-forming bacteria had been both rapid and *relatively* complete.*

INDOL curve.—In this series no special records were kept as regards the indol curve.

SPORES OF B. ENTERITIDIS SPOROGENES (Klein).—The result obtained by the use of the above test are shown in Table III.

TABLE III.

Showing, as regards the number of spores of B. ENTERITIDIS SPOROGENES, the results of the Bacteriological Examination of Soils A; 1, 2, 3, 4, 5, 6; and of a sample of cesspool sewage.

[Part I., Series I.]

Description of the Sample.	Number of Spores of B. Enteritidis Sporogenes per gramme of Soil.		
	At least 100.	At least 1,000.	At least 10,000.
Soil A. Collected before the inoculation of the soil. July 6th, 1900.	+	+	-
Cesspool sewage, July 9th, 1900	+	-	-
Soil 1. Collected immediately after the inoculation of the plot, July 9th, 1900.	+	-	-
Soil 2. Collected 2 days after the inoculation, July 11th, 1900.	+	-	-
Soil 3. Collected 7 days after the inoculation, July 16th, 1900.	+	-	-
Soil 4. Collected 14 days after the inoculation, July 23rd, 1900.	+	-	-
Soil 5. Collected 17 days after the inoculation, July 26, 1900.	+	-	-
Soil 6. Collected 24 days after the inoculation, August 2, 1900.	+	+	-

It will be seen from this table that the soil before inoculation, so far as could be judged from the results of the examination of a

* It must be understood that the absence of "gas" in gelatine "shake" cultures in 24 hours at 20° C., when using a certain amount of a substance, be it soil sewage or water, does not *necessarily* imply the *total* absence of gas-producing bacteria from that amount, but only that these microbes are not present in numbers sufficient to produce a visible development of "gas." A negative result thus implies *relative*, by no means of necessity total, absence of gas-forming bacteria.

single sample, contained at least 1,000 but less than 10,000 spores of B. enteritidis sporogenes. The cesspool sewage contained 100 but less than 1,000. The samples of soil subsequent to inoculation contained 100 but less than 1,000, with the exception of Soil 6, which contained 1,000 but less than 10,000. The large number of spores of B. enteritidis in the soil prior to inoculation was a serious disadvantage here, because the sewage added, although large in amount and containing B. enteritidis in abundance, could perhaps hardly be expected materially to increase the number of B. enteritidis sporogenes per gramme of soil. As a matter of fact, fewer spores were found, except as regards 6, where the number was the same. Probably the average number of spores of B. enteritidis per gramme of the soil previous to inoculation was nearer 100 than 1,000, and the addition of the cesspool sewage did not materially affect the number. At all events no reduction in the number of spores would seem to have taken place during the period of observation, since Soil 6 (24 days after inoculation) contained more spores than Soils 1, 2, 3, 4, and 5, collected respectively immediately after, 2 days after, 7 days after, 14 days after, and 17 days after the inoculation of the plot with cesspool sewage.

*B. COLI.**—The results as regards B. coli (and closely allied forms) may be summed up as follows:—

SOIL A (before inoculation).—No B. coli in surface phenol (0·05 per cent.) gelatine plate cultures containing respectively 0·001, 0·0001, and 0·00001 of a gramme.

Cesspool sewage.—B. coli present in 0·001 and 0·0001 cc. (*See* Microbes 1 and 2, Table V.)

SOIL 1 (immediately after the inoculation).—Unfortunately the dilutions made were too great, as it was anticipated that the pollution of the soil would greatly increase the number of coli-like microbes. No B. coli could be found in surface phenol gelatine plate cultures containing 0·0001, 0·00001 and 0·000001 gramme.

SOIL 2 (2 days after the inoculation).—B. coli present in 0·001 and 0·0001 gramme. (*See* microbes 3 and 4, Table V.)

SOIL 3 (7 days after the inoculation).—No B. coli could be found in surface phenol gelatine plate cultures containing 0·001, 0·0001, and 0·00001 gramme.

* It must be remembered that the difficulties in this direction were greatly increased by the fact that not one strain of B. coli was added to the soil, but all the different races of coli-like microbes present in the sewage.

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SOIL 4 (14 days after inoculation).—Microbes 5, 6, and 7 (Table 5) were isolated from 0·001 gramme. Possibly microbe 5 might be regarded as remote kin to B. coli, but in comparison with microbes 3 and 4 the kinship was of an extremely remote kind. Microbes 6 and 7 on further study were differentiated from B. coli, the latter with certainty, the former less surely.

SOIL 5 (17 days after the inoculation).—Microbe 8 was isolated from 0·001 gramme (surface phenol, 0·05 per. cent. gelatine plate culture), and microbes 9 and 10 from plate cultures made respectively from phenol (0·05 per cent.) broth cultures containing 0·1 and 0·01 gramme (after incubation at 37° C. for 24 hours). None of these could be regarded as even remotely akin to B. coli.

In summary at this stage it is to be noted that whereas Soil 2 contained completely typical B. coli in 0·0001 gramme, Soils 3, 4 and 5 contained no B. coli of *comparable* sort in a similar or even much larger quantity.

SOIL 6 (24 days after the inoculation).—From this soil microbes 11–17 were isolated. Microbes 11, 13, 14, and 16 were easily determined not to be B. coli. But microbes 12, 15, and 17 gave rise to a good deal of trouble in their study. Microbe 12 was isolated from 0·0001 gramme (surface phenol gelatine plate culture), and although it finally liquefied the gelatine after three weeks, gave no indol reaction, and was somewhat atypical in the manner of its growth in gelatine oblique and plate cultures, it produced "gas" in 24 hours in gelatine "shake" culture, acid clotting of milk and uniform turbidity of broth in 24 hours at 37° C. Microbes 15 and 17 were isolated respectively from 0·1 and 0·01 gramme of the soil by the primary broth and subsequent plating method. They seemed to be identical with microbe 12, but neither of them liquefied gelatine within one month.

In considering the results it is to be specially noted that B. coli was absent (or relatively so) from Soil A, but that B. coli (typical in all respects) was present in 0·0001 cc. of the cesspool sewage and 0·0001 gramme of Soil 2 (2nd day after the inoculation). Yet in Soil 3 no B. coli could be found in 0·001 gramme, and in Soil 5 none in 0·1 gramme. In Soil 4 a microbe (5) only doubtfully to be considered akin to B. coli was isolated from 0·001 gramme, and from Soil 6 three microbes (15, 17, 12) were isolated respectively from 0·1, 0·01, and 0·001 gramme, which bore in many respects a considerable resemblance to B. coli. Possibly in the

case of Soil 6 the wet weather then prevailing allowed a multiplication of the coli-like microbes still persisting in the soil to take place. At all events it is quite clear that whatever measure of doubt may exist as regards the identity with B. coli of microbes 5, 12, 15, and 17, no B. coli of comparable sort to those found in the cesspool sewage and in Soil 2 (2nd day after the inoculation) could be isolated from Soils 3, 4, 5, and 6, collected respectively 7, 14, 17, and 24 days after the inoculation.

These results, as regards their main features, are shown in Table IV., and in Table V. an account is given of the results of the subculture of the coli-like microbes isolated from the various samples.

TABLE IV.

Showing as regards B. COLI (and allied forms) the results of the Bacteriological Examination of Soils A; 1, 2, 3, 4, 5, 6; and a sample of cesspool sewage.

[Part I., Series 1.]

Description of the Sample.	0·1 Gramme.	0·01 Gramme.	0·001 Gramme.	0·0001 Gramme.	0·00001 Gramme.
Soil A. Collected before the inoculation of the soil, July 6th, 1900.	..	..	-*	-*	-*
Cesspool sewage, July 9th. 1900	..	..	+*cc.	+*cc.	-*cc.
Soil 1. Collected immediately after the inoculation, July 9th, 1900.	..	..	..	-*	-*
Soil 2. Collected 2 days after the inoculation, July 11th, 1900.	..	..	+*	+*	-*
Soil 3. Collected 7 days after the inoculation, July 16th, 1900.	..	..	-*	-*	-*
Soil 4. Collected 14 days after the inoculation, July 23rd, 1900.	..	..	?+*¶	-*	-*
Soil 5. Collected 17 days after the inoculation, July 26th, 1900.	-	-§	-*	-*	-*
Soil 6. Collected 24 days after the inoculation, August 2nd, 1900.	?+§‖	?+§‡	-*	?+*†	-*

* Surface phenol (0·05 per cent.) gelatine plate cultures.

§ Primary phenol (0·05 per cent.) broth cultures (24-48 hours at 37° C.) and subsequent surface phenol (0·05 per cent.) gelatine plate cultures.

¶ See Microbe 5. Table V.
† " " 12, "
‖ " " 15, "
‡ " " 17, "

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TABLE V.

Showing the results of subculture of the COLI-LIKE microbes met with in cultures made from the cesspool sewage and in the various samples of soil. In some cases, in order to test further the negative evidence as to B. coli, subcultures were made from colonies bearing only a remote resemblance to B. coli.

[Part I., Series 1.]

Microbe.	Source	Broth: For (a) diffuse cloudiness in 24 hours; and (b) indol test on 5th day at 37° C. (a.)	(b.)	Gelatine "shake" cultures for "gas" formation, 20° C.	Litmus milk: For (a) acidity; and (b) clotting at 37° C. (a.)	(b.)	Remarks.
	No microbes resembling B. coli were found in Soil A (before the inoculation), so no subcultures were made.						
1	0·0001 cc. cesspool sewage.*	+	+	+	+	+	Strong acid and solid clot in milk by 2nd day. Microbe in every way typical of B. coli.
2	0·001 cc. cesspool sewage.*	+	+	+	+	+	" " "
	In the case of Soil 1, collected immediately after the inoculation, the dilutions made were too great, and so B. coli was not isolated.						
3	0·001 grm. Soil 2; 2 days after inoculation.*	+	+	+	+	+	Strong acid and solid clot in milk by 2nd day. Microbe in every way typical of B. coli.
4	0·0001 " "	+	+	+	+	+	" " "
	In Soil 3 (7 days after the inoculation) no colonies sufficiently like B. coli to merit subculture.						
5	0·001 grm. Soil 4; 14 days after inoculation.*	+	-	+	+ (faint).	-	In gelatine plate and oblique cultures the growth was not altogether characteristic of B. coli.
6	" "	+	-	-	+	+	Acid clotting of milk was delayed until the 5th day. Moreover, the growth in gelatine plate and oblique cultures was atypical.
7	" "	+	-	-	-	-	Could not be regarded as even a remote ally of B. coli.

* Surface phenol (0·05 per cent.) gelatine plate cultures.
§ Phenol (0·05 per cent.) broth cultures (24-48 hours at 37° C.) and subsequent plating.
Unless otherwise stated, none of these microbes liquefied gelatine (30 days at 20° C.).

TABLE V.—*continued.*

Microbe.	Source.	Broth: For (a) diffuse cloudiness in 24 hours; and (b) indol test on 5th day at 37° C. (a.)	(b.)	Gelatine "shake" culture for "gas" formation, 20° C.	Litmus milk: For (a) acidity; and (b) clotting at 37° C. (a.)	(b.)	Remarks.
8	0·001 grm. Soil 5; 17 days after inoculation.*	Atypical.	-	-	Atypical.	Atypical.	The growth in broth and milk was atypical, and organism finally liquefied gelatine.
9	0·1 „ „ §	+	-	-	Faded look.	-	Same remarks as microbe 7.
10	0·01 „ „ §	+	-	-	„	-	„ „ „
11	0·001 grm. Soil 6; 24 days after inoculation.*			-			As this microbe gave no "gas" it was not studied further.
12	0·0001 „ „	+	-	+	+	+	Microbe liquefied gelatine after 3 weeks. The growth in gelatine plate and oblique cultures was not typical.
13	0·00001 „ „			-			Same remarks as microbe 11.
14	0·1 „ „ §			-			„ „
15	0·1 „ „ §	+	-	+	+	+	Same remarks as microbe 12, but no liquefaction of gelatine.
16	0·01 „ „ §			-			Same remarks as microbe 11.
17	0·01 „ „ §	+	-	+	+	+	Same remarks as microbe 15.

* Surface phenol (0·05 per cent.) gelatine plate cultures.
§ Phenol (0·05 per cent.) broth cultures (24–48 hours at 37° C.) and subsequent plating.
Unless otherwise stated, none of these microbes liquefied gelatine (30 days at 20° C.).

STREPTOCOCCI.—The results as regards streptococci may be briefly outlined as follows:—

SOIL A, *i.e.*, before inoculation. No streptococci could be found in surface agar plate cultures (incubated at 37° C.) containing 0·001, 0·0001, and 0·00001 gramme.* Although there were no colonies in the plates at all suggestive of streptococci, four subcultures were made in broth from those colonies least unlike streptococci; but the result was negative.

* It is perhaps hardly necessary to explain that in making cultures of a substance it is imperative not to use too much of that substance, otherwise the plates will be overcrowded and no observations of any value can be made.

Cesspool sewage.—Streptococci A and B isolated from 0·001 cc. (agar at 37° C.), and streptococcus C. from 0·001 cc. (gelatine at 20° C.).

SOIL 1.—Streptococcus I. isolated from 0·0001 gramme (agar at 37° C.), and streptococci II. and III. from 0·0001 gramme (gelatine at 20° C.).

SOIL 2.—[? Streptococcus IV.] isolated from 0·00001 gramme (agar at 37° C.). This microbe, however, was finally classed as a bacillus simulating a streptococcus. Here six subcultures in broth were made of the smallest colonies occurring in the plates, but the result was negative as regards the presence of streptococci.

SOIL 3. SOIL 4. SOIL 5. SOIL 6.—No streptococci could be found in 0·001, 0·0001, and 0·00001 gramme (surface agar plate cultures at 37° C.). Although in none of the plates (12 in number) were there any colonies really suggestive of streptococci, 13 subcultures in broth were made from one or another of the plates. The result was negative in all cases as regards the presence of streptococci.

It will thus be seen that no streptococci were found in the soil prior to inoculation; that streptococci A, B and C were obtained from the cesspool sewage; that streptococci I., II. and III. were isolated from Soil 1; and that no streptococci could be found in Soils 2, 3, 4, 5 and 6. Although negative proof is proverbially difficult, there would seem to be good ground for the belief that the streptococci of the sewage rapidly perished in the soil.

Since the above facts were recorded, Dr. Horrocks' treatise on the bacteriological examination of waters has been published. The author fully agrees with my views as regards the presence of streptococci indicating objectionable animal contamination, but seems to differ from my contention that the presence of streptococci in any number points to *recent* and therefore specially dangerous pollution. It will be remembered that in the past, in drawing inferences as regards the value of this test, I have been careful to speak of streptococci *as a class*, and I have freely admitted that there *may be* individual members of the streptococcus group capable of existing and multiplying for long periods under saprophytic conditions. Possibly the microbes Dr. Horrocks isolated from old sewage in which B. coli had disappeared were of this sort. It is by no means unlikely that microbes 9, 10, 11 and 12 (Series A, Part II.) are also to be thought of in this sense. In forming conclusions on this subject, my multiple negative results subsequent to the cessation of inoculation of the soil with sewage must needs create the conviction that if *all* races of streptococci do not perish, the majority, at all

events, rapidly diminish in number. It needs to be added that Dr. Horrocks' own conclusions are free from any suspicion of dogmatic assertion.

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These results, as regards their main features, are shown in Table VI., and in Table VII. an account is given of the chief morphological and biological characters of the different streptococci isolated from the cesspool sewage and soils.

Table VI.

Showing as regards Streptococci the results of the Bacteriological Examination of Soils A; 1, 2, 3, 4, 5, 6; and a sample of cesspool sewage.

[Part I., Series 1.]

Description of the Sample.	0·001 Gramme	0·0001 Gramme.	0·00001 Gramme.
Soil A. Collected before the inoculation of the soil, July 6th, 1900.	-*	-*	-*
Cesspool sewage, July 9, 1900	+*§¶		
Soil 1. Collected immediately after the inoculation, July 9th, 1900.		+*‖§	
Soil 2. Collected 2 days after the inoculation, July 11th, 1900.	-*	-*	-*
Soil 3. Collected 7 days after the inoculation, July 16th, 1900.	"	"	"
Soil 4. Collected 14 days after the inoculation, July 23rd, 1900.	"	"	"
Soil 5. Collected 17 days after the inoculation, July 26th, 1900.	"	"	"
Soil 6. Collected 24 days after the inoculation, August 2nd, 1900.	"	"	"

* Surface agar plate cultures (37° C.).
§ Surface gelatine plate cultures (20° C.)
¶ *See* Streptococci A., B. and C., Table VII.
‖ " " I., II. and III.

TABLE VII.

Showing the chief morphological and biological characters of the STREPTOCOCCI isolated from the cesspool sewage and from Soil 1.

[Part I., Series I.]

Streptococcus.	Source.	Morphology.	Broth Cultures.	Litmus Milk Cultures.	Remarks.
	As regards Soil A (before inoculation), no streptococci could be found in agar cultures (at 37° C.) containing 0·001, 0·0001 and 0·00001 gramme.				
A	0·001 cc. cesspool sewage.*	Stains by Gram's method, short chains of cocci; some longer chains also noted. Fig. 4, Plate XVIII.	Diffuse cloudiness appearance. (37° C.)	No visible change in 2 days; later, acidity but no clot. (14 days at 37° C.)	In gelatine and agar "streak" cultures the colonies were minute and transparent-looking. No liquefaction of gelatine.
B	" " "	Stains by Gram's method, short chains showing some tendency to cohere together. Fig. 5, Plate XVIII.	" "	Strong acid and solid clot by 2nd day. (37° C.)	" " "
C	" " " §	Stains by Gram's method, extremely long chains of cocci.	Broth remains quite transparent; at the foot of the tube a white woolly growth. (20° C.)	In 2 days milk has a bleached look at foot of tube; later, acidity but no clot. (20° C.)	In gelatine and agar cultures at 20° C., the colonies under a low power of the microscope were small and transparent-looking, and seemed to be composed of an irregular entanglement of loops of cocci. Growth more luxuriant at 20° C. than at 37° C. No liquefaction of gelatine.
I.	0·0001 gramme, Soil 1. Collected immediately after the inoculation.*	Stains by Gram's method, chains of medium length. Fig. 6, Plate XVIII.	Broth quite transparent; at the foot of the tube white granular deposit occurring as small granules and larger flake-like masses. (37° C.)	In 2 days at 37° C. strong acid and solid clot.	In gelatine and agar "streak" cultures the colonies were minute and transparent-looking. No liquefaction of gelatine.

* Surface agar plate cultures at 37° C.   § Surface gelatine plate cultures at 20° C.

TABLE VII.—*continued.*

Streptococcus.	Source.	Morphology.	Broth Cultures.	Litmus Milk Cultures.	Remarks.
II.	0·0001 gramme, Soil 1. Collected immediately after the inoculation.§	Stains by Gram's method, extremely long chains of cocci.	Broth quite transparent; at the foot of the tube white cumulus-like growth. (20° C.)	In 2 days whitening towards foot of tube; later, acidity but no clot. (20° C.)	In gelatine and agar cultures at 20° C., the colonies under a low power of the microscope appear to be made up of a loose tangle of loops of cocci. Grows better at 20° C. than 37° C. No liquefaction of gelatine. Resembles somewhat closely streptococcus C.
III.	" " "	" "	" "	" "	" " "
?IV.	On attentive study of the morphological and biological characters of this microbe (isolated from 0·00001 gramme, Soil 2), the conclusion was reached that it was really a bacillus simulating a streptococcus.				
	As regards Soils 3, 4, 5 and 6, collected respectively 7, 14, 21 and 24 days after the inoculation, no streptococci could be found in agar cultures (at 37° C.) containing 0·001, 0·0001, and 0·00001 gramme.				

§ Surface gelatine plate cultures at 20° C.

SUMMARY OF SERIES I.

In general summary of the results obtained in Series 1, and dealing only with the more important facts, it may be said that:—

1. "*Gas*" *in gelatine* "*shake*" *cultures* (24 hours at 20° C.).—Soil A (before inoculation) gave a barely positive result with 0·01 gramme; whereas the cesspool sewage a distinctly positive result with a like quantity (0·01 cc.). In the case of Soil 1 the dilutions made were too great, but in Soil 2 (2 days after the inoculation) a positive result was obtained even with 0·0001 gramme. Yet in Soils 3, 4, 5 and 6, collected respectively 7, 14, 17 and 24 days after the inoculation, the result was negative in

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each case. There would seem, then, to be no doubt that the gas-forming bacteria diminished in number very rapidly in the inoculated soil, although there was for a short while some indication of their multiplication (Soil 2.).*

2. *Spores of B. enteritidis sporogenes.*—The results obtained in this direction were inconclusive, owing to the large number of spores of B. enteritidis already present in the soil, and to the fact that addition of the sewage did not increase their number to a demonstrable extent. But as Soil 6 contained 1,000, and Soils 2, 3, 4, 5 only 100, spores per gramme, it is perhaps permissible to conjecture that at all events no material decrease could have taken place in the number of B. enteritidis sporogenes during the period of observation.

3. *B. coli.*—Notwithstanding that completely typical B. coli was present in abundance in the cesspool sewage and in Soil 2 (collected two days after the inoculation), no B. coli whatever of comparable sort could be found in Soils 3, 4, 5 and 6, collected respectively 7, 14, 17 and 24 days after the inoculation. But from Soil 5 a microbe was isolated bearing some resemblance to B. coli., and from Soil 6 several bacteria of doubtful sort. Possibly in the case of Soil 6, the wet weather prevailing between the dates of collection of Soils 5 and 6 allowed a recrudescence of vitality to take place of the coli-like microbes still persisting, although in greatly reduced numbers, in the soil. Beyond question, the results as a whole indicate that B. coli may rapidly lose its vitality in soil under certain conditions, and if not completely disappearing, become, at all events, greatly attenuated in numbers.

4. *Streptococci.*—In Soil A (before inoculation) no streptococci were found, whereas in the cesspool sewage and in Soil 1 (collected immediately after the inoculations) streptococci were isolated from 0·001 cc. and 0·0001 grammes respectively. In Soils 2, 3, 4, 5 and 6, no streptococci were found, so it may be argued that the evidence was somewhat strongly in favour of their having perished in the soil or become so reduced in numbers as to be no longer capable of demonstration.

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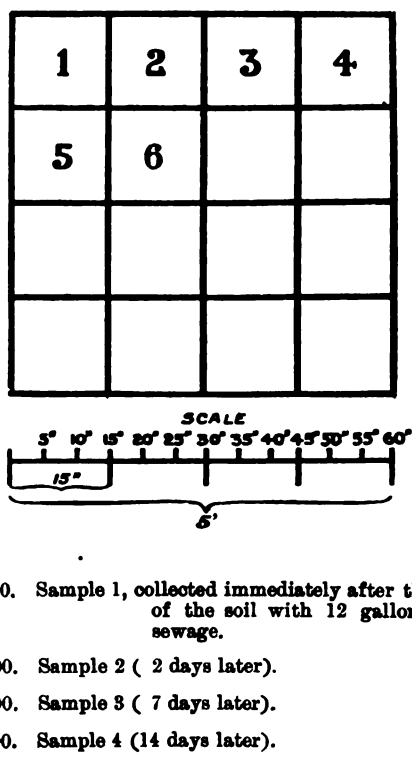
* As regards the possibility or probability of the sewage microbes being washed off the surface or carried downwards into the deeper layers of soil by successive rainfalls, all that need be said is this :—On May 21st, 1898, a plot of land closely adjacent to the one under consideration was inoculated with B. prodigiosus. 158 days later B. prodigiosus was recovered from the soil. From this experiment it may be inferred that rain need not necessarily be instrumental in washing off the surface or carrying downwards into the deeper layers of soil implanted microbes within, at all events a reasonable time.

DIAGRAM 1.

Showing the plot of land used for the soil inoculations (Part I., Series 1). The soil was inoculated with 12 gallons of cesspool sewage (July 9, 1900).



July	9, 1900.	Sample 1, collected immediately after the inoculation of the soil with 12 gallons of cesspool sewage.
July	11, 1900.	Sample 2 (2 days later).
July	16, 1900.	Sample 3 (7 days later).
July	23, 1900.	Sample 4 (14 days later).
July	26, 1900.	Sample 5 (17 days later).
August	2, 1900.	Sample 6 (24 days later).

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SERIES 2.

From August 13th to September 22nd (both dates inclusive) the same plot was watered bi-weekly with 12 gallons of the cesspool sewage. In one week, however, August, the plot was only watered once, and on more than one occasion the soil would not absorb the whole of the sewage. On these occasions as much was put on as the land could hold. A final watering (12 gallons) was made on September 24th, and immediately afterwards sample A was collected. The dates of collection of subsequent samples were as follows:—September 26th; October 1st, 8th, 11th, 18th, 25th; November 2nd, 8th, 15th, 22nd, 29th; December 6th, 13th (Diagram 2, page 445.)

In Series 1 an approximate estimate was made of the total number of microbes and of the number of bacteria of different sort added to the soil as a result of its inoculation with 12 gallons of sewage. In the present case (Series 2), and erring largely on the safe side, it may be said that these figures must be multiplied at least eight times to represent the contamination of the soil. This means that during the above period there was intermittently added to the soil about 856 thousand million bacteria, 4,360 million B. coli, 64 million spores of aërobic bacteria, at least 40 million spores of B. enteriditis sporogenes, 432 million streptococci, and a vast multitude of gas-forming bacteria.

TOTAL NUMBER of bacteria, inclusive of spores (gelatine at 20° C.), and *number of SPORES of aërobic bacteria* (gelatine at 20° C., after preliminary heating to 80° C. for 10 minutes).

These results may conveniently be considered together (Table VIII.).

TABLE VIII.

Showing as regards (1) TOTAL NUMBER of bacteria, and (2) number of SPORES of aërobic bacteria, the results of the Bacteriological Examination of Soils A, B, C, D, E, F, G, H, I, J, K, L, M, N.

[Part I., Series 2.]

Description of the sample of Soil.	Total Number of Bacteria per gramme of Soil.	Number of Spores of Aërobic Bacteria per gramme of Soil.	Ratio of Total Numbers to Spores.
Soil A. Collected immediately after the last inoculation, September 24th, 1900.	5,800,000	330,000	About 17:1
„ B. 2 days later, September 26th, 1900 ..	13,000,000	4,400,000	„ 3:1
„ C. 7 „ „ October 1st, 1900 ..	7,200,000	1,400,000	„ 5:1

TABLE VIII.—*continued.*

Description of the sample of Soil.	Total Number of Bacteria per gramme of Soil.	Number of Spores of Aërobic Bacteria per gramme of Soil.	Ratio of Total Numbers to Spores.
Soil D. 14 days later, October 8th, 1900 ..	8,000,000	4,800,000	About 1·6 : 1
„ E. 17 „ „ „ 11th, 1900 ..	3,200,000	1,000,000	„ 3 : 1
F. 24 „ „ „ 18th, 1900 ..	8,700,000	1,010,000	„ 8 : 1
„ G. 31 „ „ „ 25th, 1900 ..	9,800,000	1,200,000	„ 8 : 1
„ H. 39 „ „ November 2nd, 1900 ..	8,700,000	1,600,000	„ 5 : 1
„ I. 45 „ „ „ 8th, 1900 ..	4,000,000	1,200,000	„ 3 : 1
„ J. 52 „ „ „ 15th, 1900 ..	5,300,000	1,480,000	„ 3 : 1
„ K. 59 „ „ „ 22nd, 1900 ..	9,000,000	1,070,000	„ 8 : 1
„ L. 66 „ „ „ 29th, 1900 ..	7,000,000	2,400,000	„ 3 : 1
„ M. 73 „ „ December 6th, 1900 ..	6,500,000	1,600,000	„ 4 : 1
„ N. 80 „ „ „ 13th, 1900 ..	5,000,000	1,800,000	„ 3 : 1

In considering the above results there are several points worthy of note. In the first place, it will be noticed that Soil B, collected two days after the last inoculation, contained more bacteria than Soil A, collected immediately after the addition of the cesspool sewage. A precisely comparable result was, it will be remembered, obtained in Series 1 as regards Soils 1 and 2. Secondly; in Soil A the ratio of total numbers to spores was 17 : 1, whereas in Soils B to N it was in no case more than 8 : 1; frequently only about 3 : 1. Thirdly; in comparing Series 1 (Soils 1 to 6) and Series 2 (Soils A to N), it is noteworthy that the total number of bacteria and number of spores of bacteria in the former case were, on an average, respectively, over 3 million and more than 700,000, and in the latter case, were, again respectively, over 8 million and more than 1 million per gramme: So that the watering of the soil with cesspool sewage during part of August and September would seem to have increased both the total number and the number of spores of bacteria in the soil to a considerable extent. Nevertheless, when the total amount of sewage intermittently applied to the soil during most of August and September is taken into consideration, it is difficult to escape the inference that there must have been a progressive destruction of many of the sewage microbes during the above period. Fourthly; whereas Soil B (collected two days after the last inoculation) contained 13 million bacteria per gramme, Soil E (collected 15 days later) contained only 3,200,000. Subsequently, a rise in the number of microbes took place, which was followed by another decline. Yet again, another recrudescence of vitality would seem to have occurred; and, finally, towards the close of the experiments another fall in the total bacterial flora was noted.

As regards the sort of bacteria found in the cultivations, the following notes are of some interest : —

B. mycoides.—Approximate number per gramme of soil.

Soil.	Total Number (inclusive of spores) of B. mycoides.*	Spores of B. mycoides.
A.	Very numerous.	None in 0·001
B.	200,000	60,000
C.	40,000	30,000
D.	20,000	10,000
E.	40,000	10,000
F.	100,000	None in 0·001
G.	200,000	100,000
H.	100,000	70,000†
I.	600,000	40,000
J.	100,000	None in 0·0001
K.	300,000	30,000
L.	100,000	20,000
M.	100,000	40,000
N.	300,000	None in 0·0001

It will thus be seen that the total number, and number of spores, of B. mycoides in the samples of soil was very great.

Some additional notes as regards other microbes may also be placed on record :—

SOIL A.—B. fluor. liquefaciens present in 0·001, and B. fluor. non-liquefaciens and cladothrix present in 0·0001 gramme.

SOIL B.—B. fluor. liquefaciens and non-liquefaciens both present in 0·00001 gramme. *Granular* bacillus also present in a similar amount.

SOIL C.—*Granular* bacillus present in 0·00001 gramme (*see* Figs. 2 and 3, Plate XVII.). In 0·00 1gramme a great many colonies of the fluorescent bacilli.

* From these and my previous records it is apparent that B. mycoides is apt to be as characteristic (in the sense of being specially abundant) of soils as B. coli is of sewage.

† *See* Fig. 1, plate XVI.

APP. B, No. 4.

On the Inoculation of Soil with Sewage; by Dr. Houston.

SOIL D.—*Granular* bacillus and fluorescent microbes present in very large numbers.

SOIL E.—*Granular* bacillus and cladothrix present in 0·00001 gramme.

SOIL F.—*Granular* bacillus and cladothrix present in 0·00001 gramme. Many colonies of B. fluor. liquefaciens in 0·001 and six of B. fluor. non-liquefaciens in 0·0001 gramme.

SOIL G.—Cladothrix and B. fluor. liquefaciens present in 0·0001, and B. fluor. non-liquefaciens and *granular* bacillus present in 0·00001 gramme.

SOIL H.—*Granular* bacillus and B. fluor. liquefaciens present in 0·00001 gramme.

SOIL I.—*Granular* bacillus, B. fluor. liquefaciens and non-liquefaciens, all present in 0·00001 gramme.

SOIL J.—*Granular* bacillus present in 0·00001 and B. fluorescens liquefaciens in 0·0001 gramme.

SOIL K.—*Granular* bacillus present in 0·0001 and B. fluor-liquefaciens in 0·00001 gramme.

SOIL L.—*Granular* bacillus present in 0·00001 gramme.

SOIL M.—*Granular* bacillus present in 0·00001 gramme.

SOIL N.—*Granular* bacillus present in 0·00001 gramme.

It will be gathered from the above facts, that besides B. mycoides, cladothrix, and the granular bacillus and fluorescent bacteria (liquefying and non-liquefying) are extremely numerous in soil. In the soils collected soon after the last inoculation with sewage, B. proteus seemed to be specially abundant. Further, in the plates for spores, B. mesentericus and B. subtilis were commonly encountered.*

These results confirm previous observations of mine; and I would again insist upon the importance of data (even though they be approximate only) dealing with the relative abundance of microbes of different sort in substances of widely different character. Too long has it been the custom, in the bacteriological examination of soil, sewage, and water supply (not to speak of other substances) to take account merely of presence of microbes of one or another sort, and not of their relative abundance. In this way much controversy has arisen upon points which are probably hardly open to serious discussion, and inferences drawn which in the light of fuller knowledge would seem to be quite without justification. Year after year in my reports to the Board I have ventured to emphasise the importance of this question of relative abundance of microbes, and I more strongly than ever hold now

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*** On reference to my other report in this volume, that on examination of Chichester well waters, it will be observed that B. mycoides and the *granular* bacillus were seemingly either altogether absent or relatively so from the various water samples examined, since even when the bacterial contents of 10 cc. to 100 cc. were used for cultivation purposes, their presence was not detected in the resulting cultures. The contrast between such negative results with well water and the above figures as regards soil is very striking.**

the view that in this direction lies the solution of many of the problems which confront the bacteriologist.

"*GAS*" *in gelatine "shake" cultures* (24 hours at 20° C.).

The results obtained by the use of this test are shown in Table IX.

TABLE IX.

Showing as regards "GAS" in gelatine "shake" cultures, the results of the Bacteriological Examination of Soils A, B, C, D, E, F, G, H, I, J, K, L, M, N.

[Part I., Series 2.]

Description of the sample of Soil.	"Gas" in Gelatine "Shake" Cultures (24 hours at 20° C.) inoculated with :—		
	0·01 Gramme.	0·001 Gramme.	0·0001 Gramme.
Soil A. Collected immediately after the last inoculation, September 24th, 1900.	+	-	
" B. 2 days later, September 26th, 1900 ..	+	-	
" C. 7 " " October 1st, 1900 ..	+	-	
" D. 14 " " " 8th, 1900 ..	+	-	
" E. 17 " " " 11th, 1900 ..	-		
" F. 24 " " " 18th, 1900 ..	+	-	
" G. 31 " " " 25th, 1900 ..	+	-	
" H. 39 " " November 2nd, 1900 ..	+	-	
" I. 45 " " " 8th, 1900 ..	-		
" J. 52 " " " 15th, 1900 ..	-		
" K. 59 " " " 22nd, 1900 ..	+	-	
" L. 66 " " " 29th, 1900 ..	-	-	
" M. 73 " " December 6th, 1900 ..	+	-	
" N. 80 " " " 13th, 1900 ..	+	-	

If the above experiments be divided into a first and a second half, each comprising some 40 days, it will be observed that out of the eight soils in the first half only one (E) yielded a negative result with 0·01 gramme, whereas out of the six soils in the second half, three (I, J and L) gave a negative result. The last two samples, it is true, yielded positive results, but it is perhaps permissible on the facts to infer that on the whole there was a decline in the number of "gas" forming bacteria during the progress of this experiment. In Series 1, it will be remembered that in Soils 3, 4, 5 and 6 a negative result was obtained with 0·01 gramme, whereas in most of the soils examined in Series 2 the result was positive when a similar amount was used; so that it would seem that the continued pollution, in this later experiment, of the soil with cesspool sewage had somewhat increased

the average number of gas-forming microbes. Nevertheless, when the enormous number of bacteria (capable of giving rise to gas-formation) that had been added to the plot of land is taken into consideration, it is difficult to understand why a much smaller quantity of the soil than 0·01 of a gramme did not suffice to produce "gas" in "shake" culture. The presumption is certainly in favour of the view that these gas-forming microbes artificially added to the soil in gross amount became reduced in number from one cause or another. In this connexion it must be remembered that one-hundredth part of each cc. of sewage was found capable of producing "gas" in "shake" culture, and that more than 436,000 cc. were added to the soil.

INDOL Curve.—In this series no special records were kept as regards the indol curve.

SPORES OF B. ENTERITIDIS SPOROGENES.—The results as regards the number of spores of B. enteritidis are shown in Table X.

TABLE X.

Showing as regards the number of spores of B. ENTERITIDIS SPOROGENES, the results of the Bacteriological Examination of Soils A, B, C, D, E, F, G, H, I, J, K, L, M, N.

[Part I., Series 2.]

Description of the Sample.	Number of Spores of B. enteritidis Sporogenes per gramme of Soil.		
	At least 1,000.	At least 10,000.	At least 100,000.
Soil A. Collected immediately after the last inoculation, September 24th, 1900.	+	-	-
" B. 2 days later, September 26th, 1900 ..	+	+	-
" C. 7 " " October 1st, 1900 ..	+	+	-
" D. 14 " " " 8th, 1900 ..	+	-	-
" E. 17 " " " 11th, 1900 ..	+	-	-
" F. 24 " " " 18th, 1900 ..	+	+	-
" G. 31 " " " 25th, 1900 ..	+	-	-
" H. 39 " " November 2nd, 1900 ..	+	-	-
" I. 45 " " " 8th, 1900 ..	+	+	-
" J. 53 " " " 15th, 1900 ..	+	+	-
" K. 59 " " " 22nd, 1900 ..	+	-	-
" L. 66 " " " 29th, 1900 ..	+	+	-
" M. 73 " " December 6th, 1900 ..	+	+	-
" N. 80 " " " 13th, 1900 ..	+	-	-

It will be remembered that in Series 1, although B. enteritidis sporogenes was present in 0·001 gramme of Soil A, it was absent from a similar amount of Soils 1, 2, 3, 4 and 5. In Soil 6 the number was the same as in A. At this period of fouling of the soils, then, a majority of the samples contained at least 100, but less than 1,000 spores per gramme. In Series 2 all the soils contained 1,000, and one-half of them 10,000, spores of B. enteritidis sporogenes per gramme. It is evident, then, that on the average the soil in Series 2 was richer as regards these spores than in Series 1. There was no indication of a decline in the number of B. enteritidis during the progress of the experiments (Series 2); for if we again divide Series 2 into two halves, each of about 40 days, it will be noted that in the first half (A to H) only three (B, C, F) out of the eight samples yielded a positive result with 0·0001 gramme, whereas in the second half (I to N), four (I, J, L, M) out of the six samples yielded a positive result with a like quantity of soil.

B. COLI (and closely allied forms).—This part of the work turned out to be difficult and perplexing, and the more carefully the subject was gone into the more puzzling were some of the results obtained.* For this reason it will be necessary to enter into a somewhat detailed account of the experiments.

SOIL A.—Surface phenol gelatine plates were made, containing 0·0001 0·00001 and 0·000001 gramme. Microbes 18 and 19 were isolated from 0·0001 gramme. These seemed typical B. coli in all respects, except that microbe 18 failed to produce indol, and both 18 and 19, although giving rise to strong acidity, did not clot milk. Microbes 20 and 21 (0·00001 gramme) and microbe 22 (0·000001 gramme) gave no "gas" in gelatine "shake" culture, so their further study was abandoned.

SOIL B.—Surface phenol gelatine plates were made, containing 0·001, 0·0001 and 0·00001 gramme. Microbes 23 and 24 (0·00001 gramme) gave no "gas," so they were not studied further. Microbes 25, 26 and 27 were isolated from 0·0001 gramme. These were typical B. coli in all respects, except that 25 and 26 failed to produce indol.

SOIL C.—Cultures as in B.—Microbes 28 (0·001 gramme) and 29 (0·0001) were typical B. coli, except that neither gave indol and 29 produced no clot in milk culture. Microbe 30 (0·00001 gramme) gave no "gas," and was not studied further.

SOIL D.—Cultures as in B; but as well a broth culture was made with 0·01 gramme. This was incubated for 24 hours at 20° C. and then a plate culture made. In none of the plates were there any colonies sufficiently like B. coli to merit subcultures.

At this stage (14th day after the soil-inoculation) it almost appeared as if B. coli had disappeared from the soil. But the examination of the very next sample showed that this was by no means really the case.

SOIL E.—Cultures as in D.—Microbes 31 and 32 (0·0001 gramme) gave no gas, and so were not studied further. Microbe 33 (0·001 gramme) was, however, typical B. coli in all respects. Microbes 34 and 35 (0·0001 gramme) gave no indol and no clot in milk culture. Microbes 36, 37 and 38 (0·01 gramme,

* It needs, I think, to be remembered that difficulties arise in the bacteriological examination of soils which are not encountered, or encountered only to a moderate extent, in the examination of sewage and of water supply.

broth method) were typical B. coli,* except as regards indol, and 37 failed to produce clotting in milk culture.

SOIL F.—Cultures as in D.—Microbes 39, 40 and 41 were isolated from 0·0001 gramme. 39 and 40 gave "gas" but no indol, the broth cultures were not quite typical, and in milk cultures hardly any acid was produced and no clot. 41 was discarded, as it gave no "gas" in "shake" culture.

SOIL G.—Surface phenol gelatine plates, containing 0·001, 0·0001 and 0·00001 gramme, and also 0·1 gramme, broth method. Microbe 42 (0·001 gramme), although giving no response to the indol test, was by no means atypical in other respects. 43 (0·00001 gramme) was somewhat similar in character, but gave no clot in milk culture. 44 (0·1 gramme, broth method) was seemingly typical B. coli in all respects.

SOIL H.—Cultures as in G.—Microbe 45 (0·1 gramme, broth method) gave "gas," diffuse cloudiness, and acidity, but no indol or clot. Microbes 46 (0·001 gramme), 47 (0·0001 gramme) and 48 (0·00001 gramme) gave no "gas."

SOIL I.—Cultures as in G.—Microbe 49 (0·00001 gramme) gave no "gas." Microbe 50 (0·0001 gramme), although giving "gas" in "shake" culture was atypical in broth and milk culture, and gave no indol. Microbe 51 (0·1 gramme, broth method) was fairly typical, but yielded no indol in broth culture and no clot in milk cultivation.

SOIL J.—Cultures as in G.—Microbes 52 and 53 (0·0001 gramme) gave no "gas" in "shake" culture. But microbe 54 (0·1 gramme, broth method) seemed to be fairly typical except as regards indol (negative result), and only weak clotting ability. 55, isolated from the same plate, gave no "gas."

SOIL K.—Cultures as in G.—Microbes 56 and 57 (0·0001 gramme) gave no "gas" in "shake" culture. Microbe 58 (0·1 gramme, broth method) corresponded in its characters to 54. Microbe 59, isolated from the same plate, gave no "gas."

SOIL L.—Cultures as in G.—Microbes 60 and 61 (0·0001 and 0·001 gramme, respectively) gave no "gas." Microbe 62 (0·1 gramme, broth method) corresponded in its characters to 54.

SOIL M.—Cultures as in G.—Microbes 63 (0·001 gramme), 64 and 65 (0·0001 gramme), and 66 (0·00001 gramme), were fairly typical, but none of them gave any indol or clot, and 64 and 66 produced but little acid, and 64, 65 and 66 were, perhaps, not quite characteristic as regards their growth in broth culture. Microbes 67 and 68 (0·1 gramme, broth method) gave no "gas." 69 seemed fairly typical, but no indol was produced in broth culture nor clot in milk.

SOIL N.—Cultures as in G.—Microbe 70 (0·00001 gramme) gave "gas" in "shake" culture and diffuse cloudiness in broth, but no indol, no clot, and atypical appearance in milk. Microbe 71 (0·0001 gramme) and 72 (0·001 gramme) were not quite typical in broth and milk cultures, and gave no indol. Microbe 73, however, seemed to be in every respect typical B. coli; that is typical as regards fulfilment of all of a number of positive tests, although both as regards this microbe and a number of others, the growth in oblique gelatine and gelatine plate cultures was, perhaps, not altogether characteristic. This is the more remarkable, since 80 days had elapsed since the last inoculation.

* The use of this term may be open to criticism. It is used for convenience sake and to avoid endless repetition. In the sense used, the term "typical" means nothing more than that a microbe is not easily, if at all, to be differentiated from that *classical* B. coli, which commonly is credited with *rapid* response to *each and all* of a number of *positive* tests.

APP. B, No. 4.

On the Inoculation of Soil with Sewage; by Dr. Houston.

These results are set out in Table XI.

TABLE XI.

Showing the results of the subculture of the COLI-LIKE microbes met with in cultures made from the various samples of Soil A, B, C, D, E, F, G, H, I, J, K, L, M, N. In some cases, in order to further test the negative evidence as to B. coli, subcultures were made from colonies bearing only a remote resemblance to B. coli.

[Part I., Series 2.]

Microbe.	Source.	Broth: For (a) diffuse cloudiness in 24 hours; and (b) indol test on 5th day at 37° C. (a.)	(b.)	Gelatine "shake" cultures for "gas" formation, 20° C.	Litmus milk: For (a) acidity; and (b) clotting at 37° C. (a.)	(b.)	Remarks.
18	0·0001 grm. Soil A; immediately after last inoculation.*	+	-	+	+	-	No liquefaction, 30 days. No indol and no clot; otherwise seemed to be typical.
19	" " "	+	+	+	+	-	No liquefaction, 30 days. No clot in milk culture.
20	0·00001 " "			-			No "gas," so not studied further.
21	" " "			-			" " "
22	0·000001 " "			-			" " "
23	0·00001 grm. Soil B; 2 days later.*			-			No "gas," so not studied further.
24	" " "			-			" " "
25	0·0001 " "	+	-	+	+	+	No liquefaction, 30 days. No indol.
26	" " "	+	-	+	+	+	" " "
27	" " "	+	+	+	+	+	No liquefaction, 30 days. Seemed quite typical.
28	0·001 grm. Soil C; 7 days later.*	+	-	+	+	+	No liquefaction, 30 days. No indol.
29	0·0001 " "	+	-	+	+	-	No liquefaction, 30 days. No clot in milk culture.
30	0·00001 " "			-			No "gas," so not studied further.
	In Soil D (14 days after last inoculation) no colonies resembling B. coli, either in surface phenol gelatine plates containing 0·001, 0·0001, and 0·00001 gramme, or in plate subsequent to broth culture (0·01 gramme).						

* Surface phenol (0·05 per cent.) gelatine plate cultures.

TABLE XI.—*continued.*

Microbe.	Source.	Broth: For (a) diffuse cloudiness in 24 hours; and (b) indol test on 5th day at 37° C. (a.)	Broth (b.)	Gelatine "shake" culture for "gas" formation, 20° C.	Litmus milk: For (a) acidity; and (b) clotting at 37° C. (a.)	Litmus milk (b.)	Remarks.
31	0·0001 grm. Soil E; 17 days later.*			–			No "gas," so not studied further.
32	„ „ „			–			„ „ „
33	0·001 „ „	+	+ faint.	+	+	+ weak.	No liquefaction, 30 days. Faint indol, weak clot.
34	0·0001 „ „	+	–	+	+ slight.	–	No liquefaction, 30 days. Slight acidity and no clot in milk, and no indol in broth culture.
35	„ „ „	+	–	+	+	–	No liquefaction, 30 days. No clot and no indol.
36	0·01 „ „ §	+	–	+	+	+	No liquefaction, 30 days. No indol in broth culture.
37	„ „ „	+	–	+	+	–	No liquefaction, 30 days. No clot and no indol.
38	„ „ „	+	–	+	+	+	No liquefaction, 30 days. No indol in broth culture.
39	0·0001 grm. Soil F; 24 days later.*	? +	–	+	? +	–	No liquefaction, 30 days. Broth and milk cultures not quite typical.
40	„ „ „	? +	–	+	? +	–	„ „ „
41	0·01 „ „ §			–			No "gas," so not studied further.
42	0·001 grm. Soil G; 31 days later.*	+	–	+	+	+ weak.	No liquefaction, 30 days. No indol and weak clot.
43	0·00001 „ „	+	–	+	+	–	No liquefaction, 30 days. No indol and no clot.
44	0·1 „ „ §	+	+ faint.	+	+	+	No liquefaction, 30 days. Faint indol.
45	0·1 grm Soil H; 39 days later.§	+	–	+	+	–	No liquefaction, 30 days. No indol and no clot.
46	0·001 „ „ *			–			No "gas," so not studied further.
47	0·0001 „ „			–			„ „ „
48	0·00001 „ „			–			„ „ „

* Surface phenol (0·05 per cent.) gelatine plate cultures.
§ Phenol (0·05 per cent.) broth cultures (24 to 48 hours at 37° C.) and subsequent plating.

TABLE XI.—*continued.*

Microbe.	Source.	Broth: For (a) diffuse cloudiness in 24 hours; and (b) indol test on 5th day at 37° C. (a.)	(b.)	Gelatine "shake" cultures for "gas" formation. 20° C.	Litmus milk: For (a) acidity; and (b) clotting at 37° C. (a.)	(b.)	Remarks.
49	0·00001 grm. Soil I; 45 days later.*			–			No "gas," so not studied further.
50	0·0001 " "	? +	–	+	? +	–	No liquefaction, 30 days. No indol and no clot, and broth and milk cultures atypical.
51	0·1 " " §	+	–	+	+	–	No liquefaction, 30 days. No indol and no clot.
52	0·0001 grm. Soil J; 52 days later.*			–			No "gas," so not studied further.
53	" " "			–			" " "
54	0·1 " " §	+	–	+	+	+ weak.	No liquefaction, 30 days. No indol and weak clot.
55	" " "			–			No "gas," so not studied further.
56	0·0001 grm. Soil K; 59 days later.*			–			No "gas," so not studied further.
57	" " "			–			" " "
58	0·1 " " §	+	–	+	+	+ weak.	No liquefaction, 30 days. No indol and weak clot.
59	" " "			–			No "gas," so not studied further.
60	0·0001 grm. Soil L; 66 days later.*			–			No "gas," so not studied further.
61	0·001 " "			–			" " "
62	0·1 " " §	+	–	+	+	+ weak.	No liquefaction, 30 days. No indol and weak clot.
63	0·001 grm. Soil M; 73 days later.*	+	–	+	+	–	No liquefaction, 30 days. No indol and no clot.
64	0·0001 " "	? +	–	+	+ slight.	–	No liquefaction, 30 days. No indol and no clot, and ? milk and broth cultures atypical.
65	" " "	? +	–	+	+ slight.	–	" " "
66	0·00001 " "	? +	–	+	+ slight.	–	" " "

* Surface phenol (0·05 per cent.) gelatine plate cultures.
§ Phenol (0·05 per cent.) broth cultures (24 to 48 hours at 37° C.) and subsequent plating.

TABLE XI.—*continued.*

Microbe.	Source.	Broth: For (a) diffuse cloudiness in 24 hours; and (b) indol test on 5th day at 37° C. (a.)	(b.)	Gelatine "shake" cultures for "gas" formation. 20° C.	Litmus milk: For (a) acidity; and (b) clotting at 37° C. (a.)	(b.)	Remarks.
67	0·1 grm. Soil M; 73 days later.§			-			No "gas," so not studied further.
68	" " "			-			" " "
69	" " "	+	-	+	+	-	No liquefaction, 30 days. No indol, no clot.
70	0·00001 grm. Soil N; 80 days later.*	+	-	+	? +	-	No liquefaction, 30 days. No indol, no clot, and milk culture atypical.
71	0·0001 " "	? +	-	+	? +	-	No liquefaction, 30 days. No indol, no clot, and broth and milk cultures not typical.
72	0·001 " "	? +	-	+	? +	-	" " "
73	0·1 " " §	+	+ slight	+	+	+	No liquefaction, 30 days. Faint indol.

* Surface phenol (0·05 per cent.) gelatine plate cultures.
§ Phenol (0·05 per cent.) broth cultures (24 to 48 hours at 37° C.) and subsequent plating.

In order to form a proper apprehension of these results, it will be necessary to consider (in relation to Table XI.) each series of cultures by itself, as follows :—

(*a.*) 0·1 *gramme. Broth cultures and subsequent plating.*—It will be seen that no cultures were made in the case of Soils A to F (both inclusive) with 0·1 gramme (broth method), the reason being that it was assumed that B. coli could easily be isolated from the cultures containing much less of the soil. In Soil G a microbe (44) responding to all the positive tests for B. coli was isolated. From this date onwards (Soils H to M) the microbes isolated seemed less closely related to B. coli. Nevertheless, from Soil N, collected 80 days after the last inoculation, a microbe (73) was isolated, which gave a positive result as regards B. coli with all the tests employed.

(*b.*) 0·01 *gramme. Broth cultures and subsequent plating.*—In the case of Soils A, B and C no cultures were made, as it was anticipated that B. coli could readily be

isolated from cultures containing this smaller quantity of the soil. In Soil D (collected 14 days after last inoculation) no B. coli could be found, and at this point it almost seemed as if B. coli had perished in the soil. Yet in the next sample, E (17th day), three microbes, 36, 37 and 38, were found, all of which resembled B. coli sufficiently to merit their inclusion in the coli tribe. Soil F (24th day), however, yielded a negative result. This being so, it was thought advisable to use a larger amount of soil. Accordingly, in the case of Soils G, H, I, J, K, L, M, N, broth cultures were made containing 0·1 instead of 0·01 gramme. Reference to these cultures has already been made.

(*c.*) 0·001 *gramme. Surface phenol* (0·05 *per cent.*) *gelatine plate cultures.*—In the case of Soil A no cultures were made. As regards Soils B, I, J, K, the colonies were too crowded, and the liquefaction of the gelatine too great, to allow of accurate observations being made. Soil C (7th day) yielded typical B. coli (28), except as regards indol. Soil D (14th day) yielded a negative result. But from Soil E (17th day) a microbe (33) was isolated, typical in all respects except that its clotting power was feeble and it barely responded to the indol test. In Soil F (24th day) the result was negative. From Soil G (31st day) a microbe (42) was isolated bearing a fairly close resemblance to B. coli. A negative result was obtained with Soil H (39th day) and Soil L (66th day), the microbes (46 and 61) isolated yielding no "gas" in gelatine "shake" culture. Microbe 63 (Soil M, 73rd day) gave "gas" in "shake" culture, diffuse cloudiness in broth but no indol, and acidity in milk but no clot. From Soil N (80th day) microbe 72 was isolated, but this micro-organism was somewhat doubtfully allied to B. coli.

(*d*) 0·0001 *gramme. Surface phenol* (0·05 *per cent.*) *gelatine plate cultures.*—From Soil A (collected immediately after the inoculation) microbes 18 and 19 were isolated. The latter was typical in all respects, except that no clotting of milk occurred within five days. Microbes 25, 26 and 27 were isolated from Soil B (2nd day); the last gave a positive response to all the tests. It is to be specially noted that from this date onwards no B. coli of similar or comparable sort could be isolated from the remaining Soils C, D, E, F, G, H, I, J, K, L, M, N. Thus, microbe 29 (Soil C, 7th day) failed as regards indol in broth and clot in milk culture. In Soil D (14th day) no B. coli could be found. As regards Soil E (17th day), microbes 31 and 32 gave no "gas," microbes 34 and 35 no indol and no clot. From Soil F (24th day) microbes 39 and 40 were isolated, but these were in many respects atypical of B. coli. Microbe 47 (Soil H, 39th day) gave no "gas." Microbe 50 (Soil I, 45th day) resembled microbes 39 and 40. The microbes

(52 and 53, 56 and 57, 60) isolated from Soils J (52nd day), K (59th day), L (66th day), gave no "gas" in "shake" cultures. Microbes 64 and 65, and 71 (Soils M and N (73rd and 80th day respectively) showed no close kinship to B. coli.

(*e.*) 0·00001 *gramme. Surface phenol* (0·05 *per cent.*) *gelatine plate cultures.*—From Soils A, B, C, D, microbes 20 and 21, 23 and 24, and 30, were isolated. None of these gave rise to any "gas" formation in gelatine "shake" cultures. No B. coli were found in Soils D, E, F. From Soil G (31st day) microbe 43 was isolated. It gave "gas" in "shake" culture, diffuse cloudiness in broth but no indol, acidity in milk but no clotting. Microbes 48 and 49 were isolated from Soils H and I; they did not respond to the "gas" test. In Soils J, K, L no colonies at all resembling B. coli were noted. Microbes 66 and 70 were isolated from Soils M and N, but they did not seem to be at all closely allied to B. coli.

(*f.*) 0·000001 *gramme. Surface phenol* (0·05 *per cent.*) *gelatine plate cultures.*—Only one culture was made (Soil A) and only one sub-culture, viz., microbe 22, which gave no "gas" in gelatine "shake" culture. No further cultures were made with this minimal amount of soil.

In general summary of these results, it is to be noted that in Soils A and B no difficulty was experienced in demonstrating the presence of B. coli in abundance. In Soil C the microbes isolated seemed to be less typical. As regards Soil D (14th day), the result was wholly negative in all the plates, but in Soil E (17th day) B. coli, or at all events allied forms, still persisted. The 0·01 and 0·001 gramme cultures of Soil F (24th day) yielded negative results, and although two microbes (39 and 40) were isolated from the 0·0001 gramme cultures, they could not be regarded as being very closely allied to the strains of B. coli found in the earlier samples of soil. At this point in the investigation, be it noted, the 0·1 gramme took the place of the 0·01 gramme broth culture, so that, perhaps, no surprise need be felt that in Soil G (31st day) a microbe (44) was isolated from the large amount of soil which seemed to correspond in all respects to the races of B. coli met with in Soils A and B. From this same sample of soil microbes 42 and 43 were obtained, the former (the more typical) from the 0·001 gramme culture, and the latter (the less typical) from the 0·00001 gramme culture. But in the intermediate culture (0·0001 gramme) a wholly negative result was recorded. No "gas" forming coli-like microbes were found in the 0·001, 0·0001, and 0·00001 gramme cultures of Soil H (39th day), and microbe 45, isolated from the 0·1 gramme culture, was by no means wholly typical B. coli. Microbe 51 was obtained from a similar amount of Soil I (45th day), and resembled in all respects microbe 45. Microbe 50 (0·0001 gramme culture) was much less characteristic. Microbe 49 (0·00001 gramme culture) gave no "gas" in gelatine "shake" culture. Soils J (52nd day), K (59th day), and L (66th

day) yielded, as regards the 0·1 gramme cultures, microbes 54, 58, and 62 respectively. These, although failing with the "indol" test, and showing weak clotting ability, were otherwise not atypical But in the other cultures from the same soils, no coli-like microbes were found, or those isolated failed as regards "gas" production. Soil M (73rd day) yielded respectively from the 0·1 and 0·001 gramme cultures, microbes 69 and 63, which certainly bore some resemblance to B. coli. Microbes 64 and 65 (0·0001 gramme), and microbe 66 (0·00001 gramme) seemed to be less closely related to B. coli. As regards Soil N (80th day) it was certainly a little surprising to find a microbe (73) responding to all the tests for B. coli. Microbes 72, 71 and 70 (0·001, 0·0001, and 0·00001 gramme cultures, respectively) were, perhaps, somewhat doubtfully to be considered as akin to B. coli.

From these results, as regards B. coli, certain facts and considerations arise, as follows:—

1. There was definite evidence of a distinct decline in the number of coli-like microbes during the progress of the experiments. This is best seen by referring to the 0·0001 gramme series of cultures.

2. Nevertheless the total extinction of B. coli and allied forms, even at the end of 80 days, did not take place. For example, microbe 73, N soil, 0·1 gramme culture.

3. There was suggestion that, at intervals, a recrudescence of vitality of the coli tribe took place in the soil. It is possible, however, that some portions of the plot received more sewage than others, owing to the gradual formation of pockets and depressions.

4. Whether the strains of typical B. coli gradually lost their vitality in the soil while the less typical forms persisted; or, whether typical B. coli really persisted but lost in the course of time one or more of its original characters, is matter for surmise. The latter consideration, however, suggests an attractive and by no means inconceivable hypothesis.

STREPTOCOCCI.—The results as regards streptococci may be briefly outlined as follows:—

Soil A.—Streptococci V. and VI. were isolated from a surface gelatine plate culture (0·0001 gramme). No streptococci, however, were found in the agar cultures at 37° C. (0·001, 0·0001, and 0·00001 gramme).

Soil B.—Streptoccus VII. was isolated from 0·001 gramme of the soil (surface agar plate culture at 37° C.).

SOIL C.
D.
E.
F.
G.
H.
I.
J.
K.
L.
M.
N.

No streptococci could be found in 0·001, 0·0001, 0·00001 gramme (surface agar plate cultures at 37° C.). To test further the negative evidence as to streptococci, the minute colonies in the various plates (36 in number) were frequently subcultured. In this way 68 colonies were subjected to more or less attentive study. But the result was wholly negative as regards the presence of streptococci.

It will thus be seen that no streptocccci were found in any of the soils later than the 2nd day after the last inoculation. It seems reasonable to conclude that they rapidly perished in the soil, and the negative proof of their absence is strengthened both by the number of samples examined and the negative results (as regards streptococci) of subcultures of 68 minute colonies from the various plate cultures.*

These results are shown in Table XII., and in Table XIII. a brief account is given of the chief morphological and biological characters of streptococci V., VI., and VII.

TABLE XII.

Showing as regards STREPTOCOCCI the results of the Bacteriological Examination of Soils A, B, C, D, E, F, G, H, I, J, K, L, M, N.

[Part I., Series 2.]

Description of the Experiment.	0·001 Gramme. Agar at 37° C.	0·0001 Gramme. Agar at 37° C.	0·00001 Gramme. Agar at 37° C.
Soil A. Collected immediately after the last inoculation, September 24th.	-	+†	-
Soil B. Collected 2 days after the last inoculation, September 26th.	+§	-	-
Soil C. Collected 7 days after the last inoculation, October 1st.	-	-	-
Soil D. Collected 14 days after the last inoculation, October 8th.	-	-	-
Soil E. Collected 17 days after the last inoculation, October 11th.	-	-	-
Soil F. Collected 24 days after the last inoculation, October 18th.	-	-	-
Soil G. Collected 31 days after the last inoculation, October 25th.	-	-	-

* It will be remembered that the number of streptococci added to the soil by means of the cesspool sewage was approximately 432 million.
† Streptococci V. and VI. These, however, were isolated from a gelatine, not from an agar plate culture.
§ Streptococcus VII.

TABLE XII.—*continued.*

Description of the Experiment.	0·001 Gramme. Agar at 37° C.	0·0001 Gramme. Agar at 37° C.	0·00001 Gramme. Agar at 37° C.
Soil H. Collected 39 days after the last inoculation, November 2nd.	-	-	-
Soil I. Collected 45 days after the last inoculation, November 8th.	-	-	-
Soil J. Collected 52 days after the last inoculation, November 15th.	-	-	-
Soil K. Collected 59 days after the last inoculation, November 22nd.	-	-	-
Soil L. Collected 66 days after the last inoculation, November 29th.	-	-	-
Soil M. Collected 73 days after the last inoculation, December 6th.	-	-	-
Soil N. Collected 80 days after the last inoculation, December 13th.	-	-	-

TABLE XIII.

Showing the chief Morphological and Biological characters of the STREPTOCOCCI isolated from Soils A and B.

[Part I., Series 2.]

Streptococcus.	Source.	Morphology.	Broth Cultures.	Litmus Milk Cultures.	Remarks.
V.	0·0001 gramme, Soil A. Collected immediately after the last inoculation.*	Stains by Gram's method, long chains of cocci	Slight granular cloudiness; at foot of tube, white abundant granular deposit. Later, broth quite transparent, and growth at foot of tube coherent as one white mass. (20° C.)	At first a whitening at foot of tube; later, acidity, but no clot. (20° C.)	This streptococcus grew well at 20° C., but at 37° C. there was little or no growth. In agar and gelatine plate cultures (under a low power) the colonies were small and transparent-looking, and seemed to be composed of a tangle of loops of cocci. No liquefaction of gelatine.
VI.	" "	Resembled V. very closely.	Broth quite transparent; at foot of tube loose, flocculent, cloudy growth. (37° C.)	Slight whitening of litmus towards foot of tube; later, trace of acid; no clot. (37° C.)	Unlike V., this streptococcus grew well at blood-heat. In agar and gelatine plate cultures the growth resembled V. very closely.

* Surface gelatine plate culture (20° C.).

TABLE XIII.—*continued.*

Streptococcus.	Source.	Morphology.	Broth Cultures.	Litmus Milk Cultures.	Remarks.
VII.	0·001 gramme, Soil B. Collected 2 days after the last inoculation.§	Stains by Gram's method, extremely long chains of cocci. Fig. 7, Plate XVIII. and Fig. 8, Plate XIX.	Broth remains quite transparent; at foot of tube white fleecy growth.	In 24 hours very strong acid, but no clot. In 48 hours solid clot.	In agar plate cultures at 37° C. the colonies (under a low power) are small, circular, and transparent-looking. No loops can be seen at the periphery, but the colonies are granular-looking. In gelatine the colonies are minute, granular, and transparent. The edge is *clean* or presents only a slightly frayed appearance (low power). No liquefaction. Non-pathogenic in the case of mice.
	As regards Soils C, D, E, F, G, H, I, J, K, L, M, N, collected respectively 7, 14, 17, 24, 31, 39, 45, 52, 59, 66, 73, and 80 days after the last inoculation, no streptococci could be found in agar cultures (at 37° C.) containing 0·001, 0·0001, and 0·00001 gramme.				

§ Surface agar plate culture (37° C.).

SUMMARY OF SERIES 2.

In general summary* of all the results obtained in Series 2 of the investigation, the following points seem worthy of note :—

Total number of bacteria.—As compared with the average number of microbes in the soils examined in Series 1, the further and repeated inoculation of the plot during August and September would seem to have led to an increase in the total number of bacteria in the soil. But the increase was, perhaps, not so well marked as was to have been expected from the addition to the plot of a liquid in great amount swarming with micro-organisms and rich in organic pabulum. It is more than probable that some decay and death of the superadded germs took place. At first there was an increase in the number of bacteria (Soil B), this was followed by a diminution (Soil C); later a second slight rise (Soil D) took place; then a sharp decline (Soil E). In Soils F, G, H, a further rise was noted, and

* It is unavoidable to escape some repetition.

in Soil I another decline in number. The last five Soils (J, K, L, M, N) were characterised by a final rise and fall in the bacterial flora. The number of bacteria in the soils examined during the last half (about 41 days) of the experiments was less on the average than during the first half (about 39 days). There was no indication (rather the reverse) that the sewage bacteria ousted the soil bacteria.

Spores of aërobic bacteria.—The average number of spores was greater in Series 2 than in Series 1. In Soil A the number was small, but in Soil B a great increase was noted. In Soil C the number was less, but in Soil D the greatest number of spores was found. In Soil E there were much fewer spores. From this point onwards (Soils F to N) the general tendency was towards an increase in the number of spores. The spores were somewhat more numerous relative to the total bacterial flora in the last half (about 41 days) than in the first half (about 39 days) of the series of experiments.

"*Gas*" *in gelatine* "*shake*" *cultures* (24 hours at 20° C.).—On an average the soil in Series 2, as compared with Series 1, contained more gas-forming bacteria. The gas-forming bacteria were seemingly more numerous in the first half (Soils A to H, about 39 days) than in the second half (Soils I to N, about 41 days) of the series of experiments.

Spores of B. enteritidis sporogenes.—The continued and sustained pollution of the soil with cesspool sewage during August and September seemed undoubtedly to have led to an increase in the average number of spores of B. enteritidis sporogenes. Moreover, as during the last half (Soils I to N, about 41 days) as compared with the first half (A to H, about 39 days) of the series of experiments, the number of spores of B. enteritidis sporogenes was on an average greater, it seems reasonable to infer that the vitality of this pathogenic microbe remained unaffected during the progress of the experiments.

B. coli (and allied forms).—Although there was a distinct indication of a decided decrease in the number of coli-like microbes, it could not be said, even after 80 days, that B. coli had entirely disappeared from the soil. The less typical forms seemed to persist longer than the more typical, but possibly the explanation may be that the typical B. coli lost some of its original characters during its sojourn in the soil.*

Streptococci.—In Soils A and B, collected respectively immediately after and two days later than the last inoculation, streptococci were found. In none of the remaining 12 soils (C to N) were streptococci discoverable. It seems, then, hardly open to question that these sewage microbes of delicate sort rapidly perished in the soil.

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* Most of the experiments in this enquiry were carried out during autumn, winter, and spring, when the soil is apt to remain *permanently moist*. Had the experiments been carried out during the dry summer months, I think the disappearance of B. coli from the soil would have been much more rapid and relatively more complete.

DIAGRAM 2.

Showing the plot of land used for the soil-inoculations (Part I., Series 2). The soil was inoculated with cesspool sewage bi-weekly during the greater part of August and September (*see*, however, text). The last watering was made on September 24, 1900. For dimensions of plot, *see* Diagram 1.

		N	M
L	K	J	I
H	G	F	E
D	C	B	A

Soil A.—Collected immediately after last inoculation.

„ B.—Collected 2 days later, September 26.

„ C.—Collected 7 days later, October 1.

„ D.—Collected 14 days later, October 8.

„ E.—Collected 17 days later, October 11.

„ F.—Collected 24 days later, October 18.

„ G.—Collected 31 days later, October 25.

„ H.—Collected 39 days later, November 2.

„ I.—Collected 45 days later, November 8.

„ J.—Collected 52 days later, November 15.

„ K.—Collected 59 days later, November 22.

„ L.—Collected 66 days later, November 29.

„ M.—Collected 73 days later, December 6.

„ N.—Collected 80 days later, December 13.

Series 3.

During part of December, 1900, and during January and part of February, 1901, the same plot of ground was watered equally all over with cesspool sewage, on dates as follows :—

December 17th,* 20th, 24th and 29th ; 7, 6, 5½ and 7 gallons respectively.

January 3rd and 7th ; 6 and about 3 gallons† respectively. At this point sample (1) was collected.

January 12th, 14th, 15th and 16th; 6, 6, 5½ and 3 gallons respectively. At this point sample (2) was collected.

January 23rd, 24th, 26th and 28th ; in each case 6 gallons.

February 4th and 7th ; 6 gallons each time. At this point sample (3) was collected.

February 18th and 19th ; 6 gallons each time. At this point sample (4) was collected. This was the last time sewage was applied.

Altogether during the above period about 90 gallons of sewage were intermittently applied to the soil. The total amount of sewage was thus approximately the same as in Series 2.

Further samples of soil were collected on the following dates :—

Sample	(5)	February	26th ;	7	days after the last inoculation.
,,	(6)	March	5th ;	14	,, ,,
,,	(7)	,,	12th ;	21	,, ,,
,,	(8)	,,	19th ;	28	,, ,,
,,	(9)	,,	26th ;	35	,, ,,
,,	(10)	April	16th ;	56	,, ,,
,,	(11)	,,	23rd ;	62	,, ,,
,,	(12)	,,	26th ;	65	,, ,,
,,	(13)	May	1st ;	70	,, ,,
,,	(14)	,,	9th ;	78	,, ,,
,,	(15)	,,	14th ;	83	,, ,,
,,	(16)	,,	20th ;	89	,, ,,

It will thus be seen that not only after the *last* inoculation were soils submitted to examination, but that during the period covered by the inoculations Soils (1) (2) (3) were examined. (Diagram 3.)

* Antecedent to December 17th the plot was lightly raked over and fresh pegs and string were put down in place of the old, but in the same positions.

† The ground was partially frozen and some of the sewage ran off the surface.

TOTAL NUMBER of bacteria and spores of aerobic bacteria.—No estimations were made of the total number of bacteria or of their spores.

"*GAS*" *in gelatine* "*shake*" *cultures* (24 hours at 20° C.).—The results as regards gas-formation in gelatine "shake" culture are shewn in Table XIV.

TABLE XIV.

Showing as regards "GAS" in gelatine "shake" cultures, the results of the Bacteriological Examination of Soils (1), (2), (3), (4), (5), (6), (7), (8), (9), (10), (11), (12), (13), (14), (15), (16).

[Part I., Series 3.]

Description of the sample of Soil.	"Gas" in Gelatine "Shake" Cultures (24 hours at 20° C.), inoculated with :—		
	0·01 Gramme.	0·001 Gramme.	0·0001 Gramme.
Soil (1). January 7th, after inoculation made on same date.	No record.	No record.	No record.
Soil (2). January 16th, after inoculation made on same date.	+	-	
Soil (3). February 7th, after inoculation made on same date.	-		
Soil (4). February 19th, after inoculation made on same date.	+	-	
Soil (5). February 26th, 7 days after last inoculation.	-		
Soil (6). March 5th, 14 days after last inoculation.	-		
Soil (7). March 12th, 21 days after last inoculation.	-		
Soil (8). March 19th, 28 days after last inoculation.	-		
Soil (9). March 26th, 35 days after last inoculation.	-		
Soil (10). April 16th, 56 days after last inoculation.	-		
Soil (11). April 23rd, 63 days after last inoculation.	-		
Soil (12). April 26th, 65 days after last inoculation.	-		
Soil (13). May 1st, 70 days after last inoculation.	-		
Soil (14). May 9th, 78 days after last inoculation.	-		
Soil (15). May 14th, 83 days after last inoculation.	-		
Soil (16). May 20th, 89 days after last inoculation.	-		

APP. B, No. 4. On the Inoculation of Soil with Sewage by Dr. Houston.

It will be noted that Soils (2) and (4) gave a positive result with 0·01 but not with 0·001 gramme; all the other soils yielded a negative result with a like amount. Remembering that 0·01 cc. of the cesspool sewage gave a positive result, and that in Series 1 and 2, and in that now in question, about 12, 96 and 90 gallons respectively of the sewage was put on the soil, it seems obvious that not only was there no sustained multiplication of the gas-forming bacteria in the soil as a result of this sewage "treatment," but that they must largely have lost their vitality and died.

INDOL curve (indol in broth cultures incubated at 37° C. and tested on the 5th day).—These results are shewn in Table XV.

TABLE XV.

Showing as regards INDOL in broth culture (five days at 37° C.) the results of the Bacteriological Examination of Soils (1), (2), (3), (4), (5), (6), (7), (8), (9), (10), (11), (12), (13), (14), (15), (16).

[Part I., Series 3.]

Description of the sample of Soil.	Indol in Broth Culture (5 days at 37° C.).			
	0·01 Gramme.	0·001 Gramme.	0·0001 Gramme.	0·00001 Gramme.
Soil (1).* January 7th, after inoculation made on same date.	+	-		
Soil (2). January 16th, after inoculation made on same date.	+	+	-	
Soil (3). February 7th, after inoculation made on same date.	+	+	-	
Soil (4). February 19th, after inoculation made on same date.	+	+	+	-
Soil (5). February 26th, 7 days after last inoculation.	+	+	-	
Soil (6). March 5th, 14 days after last inoculation.	+	-		
Soil (7). March 12th, 21 days after last inoculation.	+	-		
Soil (8). March 19th, 28 days after last inoculation.	+	+	-	

* The soil was half frozen, and between the times of collection and examination became semi-liquid. One-half the usual amount was employed in making the dilutions.

TABLE XV.—*continued.*

Description of the sample of Soil.	Indol in Broth Culture (5 days at 37° C.).			
	0·01 Gramme.	0·001 Gramme.	0·0001 Gramme.	0·00001 Gramme.
Soil (9). March 26th, 35 days after last inoculation.	+	+	-	
Soil (10). April 16th, 56 days after last inoculation.	+	+	+	-
Soil (11). April 23rd, 62 days after last inoculation.	+	-		
Soil (12). April 26th, 65 days after last inoculation.	-			
Soil (13). May 1st, 70 days after last inoculation.	+	-		
Soil (14). May 9th, 78 days after last inoculation.	+	-		
Soil (15). May 14th, 83 days after last inoculation.	+	+ (trace).	-	
Soil (16). May 20th, 89 days after last inoculation.	+	+ (trace).	-	

It is to be noted that Soil (4), collected immediately after the last inoculation, gave a positive result with 0·0001 gramme. Soil (5), collected 7 days later, with 0·001 gramme. Soils (6) and (7), collected 14 and 21 days respectively after the last inoculation, only with 0·01 gramme. But Soils (8) and (9)—28th and 35th day after the last inoculation—showed, as regards indol, a ten-fold rise, and Soil (10)—56th day—a hundred-fold increase as compared with Soils (6) and (7). Nevertheless, the next sample (Soil (11)—62nd day) showed a hundred-fold decrease, and Soil (12)—65th day—a thousand-fold decline, in indol-producing ability. Soils (13) and (14)—70th and 78th day—gave a positive result with 0·01 gramme, and Soil (15)—83rd day—with 0·001 gramme. The last sample (Soil (16)—89th day) gave a positive result (traces) with 0·001 gramme.

Hence, with the exception of the rise at or about the 56th day, the general tendency of the indol curve* was in a downward direction.

* Too much stress, however, must not be laid on the indol test, for two reasons :—(1) There are microbes clearly belonging to the race of B. coli which nevertheless do not produce indol under parallel conditions of experiment: (2) there are micro-organisms in soil and sewage which are obviously alien to the Coli tribe, but which can produce indol in broth cultures. These latter germs, however, in sewage are certainly present in sparse proportions as compared with the myriads of indol-producing bacteria of the coli species.

APP. B. No 4.

On the Inoculation of Soil with Sewage by Dr. Houston.

SPORES OF B. ENTERITIDIS SPOROGENES.—The results are shown in Table XVI.

TABLE XVI.

Showing as regardst he number of spores of B. ENTERITIDIS SPOROGENES, the results of the Bacteriological Examination of Soils (1), (2), (3), (4), (5), (6), (7), (8), (9), (10), (11), (12), (13), (14), (15), (16).

[Part I., Series 3.]

Description of the sample.	Number of spores of B. enteritidis sporogenes per gramme of Soil.			
	At least 100.	At least 1,000.	At least 10,000.	At least 100,000.
Soil (1).* January 7th, after inoculation made on same date.	+	+	-	
Soil (2). January 16th, after inoculation made on same date.	+	+	-	
Soil (3). February 7th, after inoculation made on same date.	+	+	-	
Soil (4). February 19th, after inoculation made on same date.	+	+	+	
Soil (5). February 26th, 7 days after last inoculation.	+	+	-	
Soil (6). March 5th, 14 days after last inoculation.	+	+	-	
Soil (7). March 12th, 21 days after last inoculation.	+	+	-	
Soil (8). March 19th, 28 days after last inoculation.	+	+	-	
Soil (9). March 26th, 35 days after last inoculation.	+	+	-	
Soil (10). April 16th, 56 days after last inoculation.	+	+	-	
Soil (11). April 23rd, 63 days after last inoculation.	+	+	-	
Soil (12). April 26th, 66 days after last inoculation.	+	+	-	
Soil (13). May 1st, 70 days after last inoculation.	+	+	-	
Soil (14). May 9th, 78 days after last inoculation.	+	+	-	
Soil (15). May 14th, 83 days after last inoculation.	+	-		
Soil (16) May 24th, 89 days after last inoculation.	+	-		

* The soil was half frozen, and between the times of collection and examination became semi-liquid. One-half the usual amount was employed in making the dilutions.

In considering these results there are several points which merit attention. With the exception of Soil (4) (positive result

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with 0·0001 gramme), and soils 15 and 16 (+ ·01; — ·001 gramme) all the samples gave the same result, viz., + 0·001 and — 0·0001 gramme. As compared with Soils (1), (2), (3), (4) and (5) in Series 1, this means that there was, on an average, a tenfold increase, or thereabouts, in the number of spores of B. enteritidis. But when Series 3 is compared with Series 2, it is found that the further addition of some 90 gallons of sewage did not increase the number of these spores. On the contrary, Series 2 (on the average) seemed to contain more spores. Thus, while in Series 2 seven out of the fourteen soils yielded a positive result with 0·0001 gramme, and the remainder a positive result with 0·001 gramme, in the Series (3) now in question only one soil yielded a positive result with 0·0001 gramme, two gave a negative result with 0·001, and the remainder a positive result with 0·001 gramme. It seems difficult, therefore, to escape the conclusion that some of the spores of B. enteritidis perished in the soil. But that (for this seems to be implied) the spores of an anaerobe would be likely to develop into bacilli in the surface layers of soil, and so become susceptible to the influence of unfavourable physical conditions and to the competing influence of other bacteria, is as difficult of belief as is the proposition that the spores themselves can suffer extinction in soil within a period covered by only a few weeks or months. Indeed, the results observed are not easy of comprehension, because it must be remembered that altogether (Series 1, 2, and 3) the plot of land received not less than 1,079 million spores of B. enteritidis sporogene. This works out at 299,750 spores per square inch.

B. COLI (*and allied forms*).—In this series, four phenol (0·05 per cent.) broth tubes were inoculated severally with 0·01, 0·001, 0·0001, and 0·00001 gramme of soil. The tubes were incubated for 24 to 48 hours at 37; when those showing diffuse cloudiness were plated, and the colonies growing in these gelatine plate cultures further studied in broth, litmus milk, and gelatine "shake" cultures.*

SOIL (1).—Diffuse cloudiness in all the four broth tubes (0·01, 0·001, 0·0001 and 0·00001 gramme), so gelatine plates made from each. No coli-like microbes in 0·001 or in 0·00001 gramme. Microbes 74 and 75 isolated respectively from 0·0001 and 0·01.

SOIL (2).—Diffuse cloudiness in the 0·01, 0·001, and 0·0001, but not in 0·00001, gramme broth tubes. Nevertheless, plates made from all four. Microbes 76, 77 and 78 isolated, the first two from 0·01 and the last from 0·001. No coli-like microbes in 0·0001 and 0·00001 gramme.

SOIL (3).—Diffuse cloudiness in the 0·01, 0·001, and 0·0001, but not in 0·00001, gramme broth tubes. Nevertheless, plates made from

* On July 20th, 1901, a "general" sample of soil was collected from the whole plot of ground, small quantities of surface soil being taken from each of the 16 divisions and mixed together. The soil was examined for B. coli by the primary broth and by the subsequent plating method. No B. coli could be found, even when so much as 1 gramme of the soil was used. The soil was by this time very dry owing to the prolonged drought: this dryness, combined with the effect of the sun's rays and the competing influence of the soil bacteria, seemed to have brought about the complete destruction of B. coli.

all four Microbes 79, 80, 81 and 82 isolated respectively from 0·01 0·001, 0·001, 0·0001 plates.

SOIL (4).—Diffuse cloudiness in 0·01, 0·001, 0·0001 and 0·00001 (?) broth tubes. Plates made from all four; no coli-like microbes in 0·00001 plate. Microbes 83, 84 and 85 isolated respectively from 0·01, 0·001 and 0·0001 plates.

SOIL (5).—Diffuse cloudiness in all the broth tubes, so four plates made from them. No coli-like microbes in 0·0001 and 0·00001 plates. Microbes 86 and 87 isolated from 0·01 and 0·001 plates respectively.

SOIL (6).—Diffuse cloudiness in 0·01, 0·001, 0·0001 and 0·00001 (trace) tubes Four plates made. No coli-like microbes in 0·001, 0·0001 and 0·00001 plates. Microbe 88 isolated from 0·01 plate.

SOIL (7).—Diffuse cloudiness in 0·01, 0·001, and 0·0001, but not in 0·00001 broth tubes. Plates made from first three. No coli-like microbes in 0·00001 plate. Microbes 89 and 90 isolated from 0·01 and 0·001 plates respectively.

SOIL (8).—Some diffuse cloudiness in all four broth tubes, so plates made from each. No coli-like microbes in 0·0001 and 0·00001 plates. Microbes 91 and 92 isolated from 0·01 and 0·001 plates respectively.

SOIL (9).—Some diffuse cloudiness in all four broth tubes, so plates made from each. No coli-like microbes in 0·001, 0·0001 and 0·00001 plates. Microbe 93 isolated from 0·01 plate.

SOIL (10).—Abundant diffuse cloudiness in 0·01 and 0·001; slight cloudiness in 0·0001 and 0·00001 gramme broth tubes. Plates made from all four tubes. No coli-like microbes in 0·0001 and 0·00001 plates. From plates 0·01 and 0·001 microbes 94 and 95 isolated respectively.

SOIL (11)—Diffuse cloudiness in 0·01 and 0·001 broth tubes; 0·0001 and 0·00001 tubes atypical cloudiness. Plates made from two former. No coli-like mic obes in 0·001 plate; but from 0·01 plate microbe 96 isolated as possibly akin to B. coli.

SOIL (12)—Diffuse cloudiness in 0·01 and 0·001, but not 0·0001 and 0·00001, broth tubes. Plates made from two former. Microbes 97 and 98 isolated respectively from 0·01 and 0·001 plate.

SOIL (13).—Diffuse cloudiness in 0·01 and 0·001, but not 0·0001 and 0·00001, broth tubes. Plates made from two former. Microbes 99 and 100 isolated respectively from 0·01 and 0·001 plate.

SOIL (14.)—Diffuse cloudiness in 0·01 and 0·001, but not 0·0001 and 0·00001, broth tubes. Plates made from two former. No coli-like microbes in 0·001 plate. Microbe 101 isolated from 0·01 plate.

SOIL (15).—Diffuse cloudiness in all four broth tubes. so four plates made from them. No coli-like microbes in 0·00001 plate, but from 0·01, 0·001 and 0·0001 plates. Microbes 102, 103 and 104 isolated.

SOIL (16).—Diffuse cloudiness in 0·01 and 0·001, but not in 0·0001 and 0·00001 broth tubes. Plates made from the two former. Microbes 105 and 106 isolated respectively from 0·01 and 0·001 plates.

The above results are set out in Table XVII.

Table XVII.

Showing the results of the subculture of the Coli-like microbes met with in cultures made from the various samples of soil in Series 3 (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14. 15, 16). In some cases, in order to test further the negative evidence as to B. coli subcultures were made from colonies bearing only a remote resemblance to B. coli.

[Part I., Series III.]

Microbe.	Source.	Broth: for (a) diffuse cloudiness in 24 hours; and (b) indol on 5th day at 37° C. (a.)	(b.)	Gelatine "shake" cultures for "gas" formation, 20° C.	Litmus milk for (a) acidity; and (b) clotting at 37° C. (a.)	(b.)	Remarks.
74	0·0001 gramme Soil 1: Collected after inoculation made on January 7th, 1901.	+	-	+	+	+	No liquefaction 30 days. No indol.
75	0·01 " "	+	+ faint	+	+	+	No liquefaction 30 days. Indol faint.
76	0·01 gramme, Soil 2: Collected after inoculation made on January 16th, 1901.	+	+ faint.	+	+	+	No liquefaction 30 days. Indol faint.
77	" " "	+	+ faint	+	+	+	" "
78	0·001 " "	+	-	+	+	+	No liquefaction 30 days. No indol.
79	0·01 gramme, Soil 3; Collected after inoculation made on February 7th, 1901.	+	-	+	+	+	No liquefaction 30 days No indol.
80	0·001 " "	+	+	+	+	+	No liquefaction 30 days. Distinct indol.
81	0·0001 " "			-			No "gas," so not studied further.
82	0·00001 " "			-			" " "

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TABLE XVII.—*continued.*

Microbe.	Source.	Broth; for (a) diffuse cloudiness in 24 hours; and (b) indol on 5th day at 37° C. (a.)	(b.)	Gelatine "shake" culture for "gas" formation, 20° C.	Litmus milk for (a) acidity; and (b) clotting at 37° C. (a.)	(b.)	Remarks.
83	0·01 gramme, Soil 4; Collected after last inoculation. February 19th, 1901.	+	+	+	+	+	No liquefaction 30 days. Strong indol.
84	0·001 " "	+	-	+	+	+	Ditto, but no indol.
85	0·0001 " "	+	-	+	+	+	" " "
86	0·01 gramme, Soil 5; 7 days later. February 26th, 1901.	+	-	+	+	-	No liquefaction 30 days. No indol and no clot.
87	0·001 " "	+	-	+	+	+	Ditto, but here clot.
88	0·01 gramme, Soil 6; 14 days after last inoculation. March 5th, 1901.	+	+ faint.	+	+	+	No liquefaction 30 days. Faint indol.
89	0·01 gramme, Soil 7; 21 days after last inoculation. March 12th, 1901.			-			No "gas," so not studied further.
90	0·001 " "			-			" " "
91	0·01 gramme, Soil 8; 28th day after last inoculation. March 19th, 1901.			-			No "gas," so not studied further.
92	0·001 " "			-			" " "
93	0·01 gramme, Soil 9; 35th day after last inoculation. March 26th, 1901.	+	-	+	+	+	No liquefaction 30 days. No indol.
94	0·01 gramme, Soil 10; 56th day after last inoculation, April 16th, 1901.	+	+	+	+	+	No liquefaction 30 days. Microbe seemed to be in every way typical.
95	0·001 " "	+	+	+	+	+	" " "

TABLE XVII.—*continued.*

Microbe.	Source.	Broth: for (a) diffuse cloudiness in 24 hours; and (b) indol on 5th day at 37° C. (a.)	(b.)	Gelatine "shake" culture for "gas" formation. 20° C	Litmus milk for (a) acidity; and (b) clotting at 37° C. (a.)	(b.)	Remarks.
96	0·01 gramme, Soil 11; 62nd day after last inoculation. April 23rd, 1901.			-			No "gas," so not studied further.
97	0·01 gramme, Soil 12; 65th day after last inoculation. April 26th, 1900.	+	-	+	+	-	No liquefaction 30 days. No indol and no clot.
98	0·001 " "	+	-	+	+	-	" " "
99	0·01 gramme, Soil 13; 70th day after last inoculation. May 1st, 1901.	?+	-	+	+	-	No liquefaction 30 days. No indol and no clot, and atypical cloudiness in broth cultures.
100	0·001 " "			-			No "gas," so not studied further.
101	0·01 gramme, Soil 14; 78th day after last inoculation. May 9th, 1901.	+	-	+	+ slight.	-	No liquefaction 30 days. No indol, no clot, and only slight acidity.
102	0·01 gramme, Soil 15; 83rd day after last inoculation. May 14th, 1901.	+	-	+	+ slight.	-	No liquefaction 30 days. No indol, no clot, and only slight acidity.
103	0·001 " "	+	-	+	atypical.	atypical.	Liquefaction 7th day. No indol and milk culture quite atypical.
104	0·0001 " "	+	-	+	+ faint.	-	No liquefaction 30 days. No indol, no clot and only slight acidity.
105	0·01 gramme, Soil 16; 89th day after last inoculation. May 20th, 1901.	+	-	+	+ faint.	-	No liquefaction 30 days. No indol, no clot and only slight acidity.
106	0·001 " "	+	-	+	+ faint.	-	" " "

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In order to arrive at a proper apprehension of these results it will be necessary to consider (in relation to Table XVII.) each series of cultures by itself as follows:—

(a) 0·01 *gramme (broth cultures and subsequent plating).*—Microbes 75 and (76 and 77) were isolated respectively from soils (1) and (2). These were B. coli in all respects although giving a somewhat feeble indol reaction. Microbe 79, isolated from soil (3), seemed to be less typical since it gave a negative result as regards indol. Microbe 83, isolated from soil (4), collected immediately after the last inoculation, was in all respects B. coli. In soil (5), collected seven days after the last inoculation, the microbe (86) chosen for subculture gave a much more feeble response to positive tests. But the very next soil (6, collected one week later) yielded a microbe (88) typical in all respects although giving a somewhat feeble indol reaction. The microbes 89 and 91, isolated respectively from soils 7 (21st day) and 8 (28th day), gave no "gas" in gelatine "shake" culture. But microbe 93, isolated from soil 9 (35th day), responded to all the positive tests of B. coli except indol formation. And microbe 94, isolated from soil 10 (56th day), seemed to be quite as typical of B. coli as microbe 83 which it will be remembered was obtained from soil 4 (collected immediately after the last inoculation). Yet the very next soil (11, 62nd day) yielded a microbe (96) failing even as regards "gas" production. The remaining soils 12 (65th day), 13 (70th day), 14 (78th day), 15 (83rd day), and 16 (89th day) yielded respectively microbes 97, 99, 101, 102, and 105, all seemingly more or less akin to B. coli but giving a feeble response to positive tests as compared with, for example, microbe 83.

(b.) 0·001 *gramme (broth cultures and subsequent plating).*—Soils 2, 3 and 4 yielded respectively microbes 78, 80 and 84, all typical of B. coli except that 78 and 84 gave no indol. Soil 5 (7th day) yielded microbe 87 comparable to microbes 78 and 84. But soils 6, 7, 8 and 9 yielded either negative results or the microbes isolated failed to respond to the preliminary "gas" test. Soil 10 (56th day), however, yielded a microbe (95) corresponding in cultural character to the typical microbe (94) previously considered (0·01 gramme, series of cultures). As regards the remaining soils, 11 and 14 showed no coli-like microbes in the plate cultures made from the broth tubes. Microbe 100 was isolated from soil 13 but it gave no "gas" in "shake" culture. From soil 15 a microbe (103) was obtained which seemed to be only remotely akin to B. coli. Microbes 98 and 100, isolated respectively from soils 12 and 16, were somewhat more typical as

regards B. coli, but could hardly be compared with, for example, microbe 80 isolated from soil 3.

(c.) 0·0001 *gramme (broth cultures and subsequent plating).*—Here it is to be noted that microbe 85 was isolated from soil 4 (collected immediately after the last inoculation) and responded to all the positive tests of B. coli except indol formation. In none—with a single exception—of the remaining soils was B. coli found (either no diffuse cloudiness occurred in the original broth cultures rendering further plating unnecessary, or no microbes resembling B. coli appeared in the plate cultures from those broth tubes which did show diffuse cloudiness). The exception above referred to was soil 15. Here a microbe (104) was found which gave "gas," "diffuse cloudiness," and faint acidity; but no clot and no indol.

(d.) 0·00001 *gramme (broth cultures and subsequent plating).*—These cultures proved to be too dilute; no B. coli could be isolated even from the soils collected during the period of inoculation or immediately afterwards.

In considering these results as a whole it seems justifiable to conclude that B. coli although not disappearing (allied forms, at all events remained) altogether from the soil even after 89 days became greatly reduced in number as time went on: For, during the progress of the experiments either negative results became increasingly frequent or else the microbes isolated seemed less and less to resemble the typical B. coli. But it is also to be noted that here as in Series 2 at times there was suggestion of a recrudescence of the vitality of B. coli; for example, Soil 10 (56th day after the last inoculation). Lastly, it must, I think, be left an open question whether the less typical races of B. coli persisting in the soil, even at the end of the investigations, were derived from atypical strains of B. coli (or their progeny) originally sown on the soil in the process of the sewage inoculations, or were the offspring of originally typical races of B. coli which, by reason of their prolonged sojourn in the soil, had lost some of their previous positive characters.

I have, in this investigation, erred on the side of including microbes in the coli tribe which, perhaps, ought from their atypical character to have been rejected or at least placed in a separate category. But as my previous attitude on this subject, based on the examination of soils of diverse sort, was somewhat antagonistic to the possibility or probability of B. coli persisting in any number or for any great length of time in the surface layers of soil, I thought it better to err on the side of leniency, in a sense that is adverse to my provisional inferences.*

* However this may be, it is of great importance to note that a "mixed" sample of soil collected on July 20 (150 days after the last inoculation) from all the 16 divisions of the plot contained no B. coli in 1 gramme.

STREPTOCOCCI.—The results as regards streptococci may be briefly described as follows :—

SOIL (1).—The results were negative. The soil when collected was half frozen, and when the time came for its examination it was in a semi-liquid condition.

SOIL (2).—Streptococci A and B were isolated from 0·001 gramme of the soil (surface agar plate cultures at 37° C.).

SOIL (3).—The results were negative.

SOIL (4).—Streptococci C and [? D] were isolated from 0·001 gramme of the soil (surface agar plate cultures at 37° C.).

SOIL (5).
(6).
(7).
(8).
(9).
(10).
(11).
(12).
(13).
(14).
(15).
(16).

No streptococci could be found in 0·001, 0·0001, and 0·00001 gramme (surface agar plate cultures at 37° C.). To test further the negative evidence as to streptococci, the minute colonies in the various plates (36 in number) were frequently subcultured. In this way 44 colonies were subjected to more or less attentive study. But the result was wholly negative as regards the presence of streptococci.

It is to be noted that no streptococci could be found in any of the soils collected subsequently to Soil (9), which was collected immediately after the last inoculation. That the streptococci applied to the land in the sewage must have either lost their vitality or become greatly reduced in numbers seems hardly open to serious doubt. It will be remembered that in the cesspool sewage streptococci were isolated from $\frac{1}{1000}$ cc., and that in Series 1, 2, and 3 about 12, 96, and 90 gallons respectively of this sewage were added to the plot of land.

These results, as regards streptococcus, are shewn in Table 18, and in Table 19 a brief account is given of the chief morphological and biological characters of streptococci A, B, C, and [? D].

Table XVIII.

Showing as regards Streptococci the results of the bacteriological examination of Soils 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16.

[Part I., Series 3.]

Description of the Experiment.	0·001 Gramme Agar at 37° C.	0·0001 Gramme Agar at 37° C.	0·00001 Gramme Agar at 37° C.
Soil (1).* January 7th, after inoculation on same date.	-	-	-
Soil (2). January 16th, after inoculation on same date.	+§	-	-
Soil (3). February 7th, after inoculation on same date.	-	-	-
Soil (4). February 19th, after inoculation on same date.	+¶	-	-
Soil (5). February 26th, 7 days after last inoculation.	-	-	-
Soil (6). March 5th, 14 days after last inoculation.	-	-	-
Soil (7). March 12th, 21 days after last inoculation.	-	-	-
Soil (8). March 19th, 28 days after last inoculation.	-	-	-
Soil (9). March 26th, 35 days after last inoculation.	-	-	-
Soil (10). April 16th, 56 days after last inoculation.	-	-	-
Soil (11). April 23rd, 62 days after last inoculation.	-	-	-
Soil (12). April 26th, 65 days after last inoculation.	-	-	-
Soil (13). May 1st, 70 days after last inoculation.	-	-	-
Soil (14). May 9th, 78 days after last inoculation.	-	-	-
Soil (15). May 14th, 83 days after last inoculation.	-	-	-
Soil (16). May 20th, 89 days after last inoculation.	-	-	-

* The soil was half frozen, and between the times of collection and examination became semi-liquid. One-half the usual amount was employed in making the dilutions.

§ Streptococci A and B.

¶ Streptococcus C and (? D).

TABLE XIX.

Showing the chief Morphological and Biological characters of the STREPTOCOCCI isolated from Soils (2) and (4).

[Part I., Series 3.]

Strepto-cocci.	Source.	Morphology.	Broth Cultures.	Litmus Milk Cultures.	Remarks.
A	0·001 gramme, Soil (2), collected after inoculation of the plot of ground with cesspool sewage on January 7th, 1901. Agar at 37° C.	Very short chains of cocci; occasionally a longer chain may be seen. Fig. 9, Plate XIX.	Abundant diffuse cloudiness at 37° C. in 24 hours.	By two days, strong acid and solid clot at 37° C.	In gelatine streak culture very minute transparent-looking colonies. No liquefaction.
B	Same source as A.	Chains of cocci of medium length. Fig. 10, Plate XIX.	Slight diffuse cloudiness, but on sides and foot of tube, cirrhus - like growth. 37° C.	Faint acidity, no clot. 37° C.	In gelatine streak cultures the colonies tend to be separate, and are small and transparent-looking. No liquefaction.
C	0·001 gramme, Soil (4), collected immediately after the last inoculation, made on February 19th, 1901. Agar at 37° C.	Chains of cocci of medium length Fig. 11, Plate XIX.	The broth remains quite transparent, but on sides and foot of tube growth resembles snow - flakes. 37° C.	Little or no visible change. 37° C.	In gelatine streak cultures the colonies tend to be separa'e, and are small and transparent-looking. No liquefaction.
?D	Same source as C.	Involution forms extremely well marked; seemed on the whole to be a streptococcus, but of a peculiar type.	Diffuse cloudiness, and at foot of tube white viscous growth. 37° C.	Slight acidity, but no clot. 37° C.	The colonies in gelatine streak cultures were of streptococcus-like appearance. No liquefaction.

As regards Soils 1, 3, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, no streptococci could be found in agar cultures (at 37° C.) containing 0·001, 0·0001 and 0·0001 gramme.

Summary of Series 3.

In general summary of the results obtained in Series 3, the following points seem worthy of note :—

"*Gas*" *in gelatine* "*shake*" *culture*.—Whereas Soil 4, collected immediately after the *last* inoculation, gave a positive result with 0·01 gramme, all of the other soils (5 to 16) collected at subsequent dates yielded a negative result with the same amount. Notwithstanding the addition of an extra 90 gallons of sewage, the soils in Series 3 were less rich in gas-forming bacteria than in Series 2.

Indol curve (indol in broth cultures, at 37° C. for 5 days).—Soil (4), collected immediately after the *last* inoculation, gave a positive result with 0·0001 gramme. With the exception of Soil (10), none of the soils collected subsequently gave a positive result with a similar quantity, and a number of them yielded a negative result, even with 0·001 gramme. Beyond doubt the general tendency of the indol curve was in a downward direction.

B. enteritidis sporogenes.—The majority of the samples contained an approximately equal number of spores of this microbe. But it is curious that the last two samples showed a tenfold decrease. Moreover, only one, (4), out of the sixteen samples of soil gave a positive result with 0·0001 gramme, whereas, in Series 2, seven out of the fourteen samples yielded a positive result with a like quantity. The natural inference would be that spores of B. enteritidis sporogenes became diminished in number in the soil during the progress of the experiments. But, as has been already explained, it is difficult to conceive of the possibility of a marked decline in the number of spores of an anaërobic micro-organism occurring in the surface layers of soil during a period covered by a few weeks or months.

B. coli (and allied forms).—Beyond question the more typical strains of B. coli diminished in number during the progress of the experiment. But here, as in the preceding series of experiments, a seeming recrudescence of vitality of B. coli and allied forms was occasionally observed, and even after 89 days the complete disappearance of microbes of the coli tribe was not established. It is apparent, therefore, that soil may permit retention of vitality in certain strains of B. coli during a period covered by weeks and even months.*

Streptococci (agar at 37° C.).—It is to be noted that streptococci were isolated from 0·001 gramme of Soil (4) collected immediately after the last inoculation of the plot. In none of the soils (5 to 16) subsequently collected could any streptococci be found. That the streptococci present in the cesspool sewage perished in the surface layers of soil seems hardly open to question.

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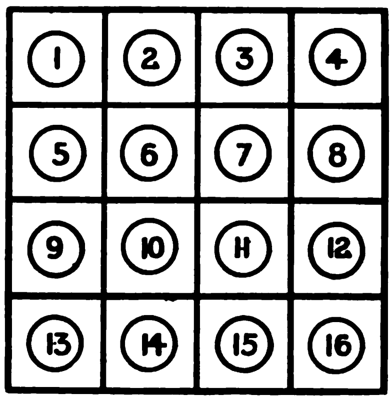
* Nevertheless a "mixed" sample of the soils collected on July 20th (150 days after the last inoculation) from all the 16 divisions of the plot contained no B. coli in 1 gramme of the mixture.

DIAGRAM 3.

Showing the plot of land used for the soil-inoculations (Part I., Series 3). The soil was inoculated with 7, 6, 5½, 7, 6, 3, 6, 6, 5½, 3, 6, 6, 6, 6, 6, 6 gallons on December 17, 20, 24, 29 (1900); January 3, 7, 12, 14, 15, 16, 23, 24, 26, 28; February 4, 7, 18, 19 (1901), respectively. For dimensions of plot, *see* Diagram 1.



SOIL	(1).—January	7.	Collected after inoculation made on same date.
„	(2).—January	16.	Collected after inoculation made on same date.
„	(3).—February	7.	Collected after inoculation made on same date.
„	(4).—February	19.	Collected after inoculation made on same date.
„	(5).—February	26.	Collected 7 days after the last inoculation.
„	(6).—March	5.	Collected 14 days after the last inoculation.
„	(7).—March	12.	Collected 21 days after the last inoculation.
„	(8).—March	19.	Collected 28 days after the last inoculation.
„	(9).—March	26.	Collected 35 days after the last inoculation.
„	(10).—April	16.	Collected 56 days after the last inoculation.
„	(11).—April	23.	Collected 62 days after the last inoculation.
„	(12).—April	26.	Collected 65 days after the last inoculation.
„	(13).—May	1.	Collected 70 days after the last inoculation.
„	(14).—May	9.	Collected 78 days after the last inoculation.
„	(15).—May	14.	Collected 83 days after the last inoculation.
„	(16).—May	20.	Collected 89 days after the last inoculation.

Through the kindness of Mr. F. Campbell Bayard I am enabled to give a table of meteorological observations carried out within half a mile of the plot of land used for the above experiments, observations which cover the whole period of the investigation. The table will be found at the end of this report. I hesitate to draw any inferences from these meteorological data in connexion with my work, because, although we know that sunshine, extreme dryness, and severe cold may act injuriously on bacterial life; and that, conversely, warmth, a moderate degree of moisture and shade may be favourable to their vitality; we cannot accurately weigh these conditions (individually or collectively) in relation to the life history of bacteria naturally existing in the soil or artificially added thereto. But as regards Series 1, it should, perhaps, be noted that the extreme heat and absence of rainfall which prevailed during the period July 9th (date of inoculation) to July 26th (date of collection of fifth sample of soil) rendered the soil very dry, and must therefore have acted prejudicially to bacterial life. Between the date of collection of Soils 5 and 6 (of Series 1) rain fell, and this may have allowed a recrudescence of the vitality of many of the bacteria in the soil to take place. During Series 2 (September 26 to December 13) of the observations, the general condition of the weather might be described as unseasonably warm; the rainfall in October and November was low, and during the whole period the samples of soil were observed to be slightly moist—never either dry or sodden with water. On two occasions only did the temperature fall below freezing point. On the whole the conditions seemed to be during this period favourable to bacterial life. During Series 3 (February 19, date of last inoculation, to May 20, date of collection of last sample) the weather was often extremely cold; but the winter was by no means a severe one, and the spring was characterised by somewhat sudden fluctuations of temperature. Throughout this last period the soil remained moist until April 23rd (sample 11), and all the remaining samples (with the exception of 14) were very dry. Doubtless the degree of moisture in a soil at a given time is a most potent factor in relation to its bacterial composition.

C.—PART II.—Series A.

Inoculation of soil "in urbe" with London crude sewage.

This portion of my soil-investigations relates to work carried out, not in the country but in town, and comprised repeated inoculation of a soil with London crude sewage.

The soil (loam) used was supposed not to have been manured, at all events it had not *recently* been manured. It was placed in a specially constructed wooden box having the following internal dimensions:—about 50 inches long, 12 inches wide, and 14 inches in depth (diagram 4). The soil (about four bushels) filled the box to within about three inches of the rim. At the bottom of the box numerous holes were pierced, and previous to the introduction of the soil these were loosely covered with fragments of a broken flower-pot. The box was supported on half-inch battens to allow the surplus liquid to escape freely and to prevent the wood from rotting. By a simple arrangement of small screw nails and stout string attached to the upper rim of the box, the surface area of the soil was divided into twenty equal divisions (about 6″ × 5″). The box was placed in a back garden in Kensington, in a position sheltered by adjoining walls and shrubs from the direct rays of the sun, except during a very small portion of the afternoon.

Samples I. and II. were collected on December 5 and 10 respectively, and before the inoculation was commenced. On December 20, 22, 24, 27, 29 and 31, and on January 2 and 4, the contents of the box were watered equally all over with four gallons of London crude sewage. Just before re-applying the sewage on January 4, sample III. of soil was collected. Further inoculations (four gallons) were made on January 7, 9, 12 and 14. Immediately after the application of sewage on January 14, sample IV. of soil was collected. Like inoculations of the soil were carried out on January 16, 19, 21, 23, 26, 28 and 30. Sample V. of soil was collected immediately after the last inoculation. Altogether 76 litres of sewage* were added to the soil. The sewage was collected from a main sewer in the Kensington district. So far as may be judged from my numerous records of bacteriological examination of London crude sewage as it is discharged at the Northern and Southern outfall works, the bacterial constituents of the sewage in question would be likely to be as follows:—1-10 million bacteria, 100,000 B. coli, at least 100 spores of B. enteritidis sporogenes, and 1,000 streptococci per cc. Further, I would expect that $\frac{1}{1000}$ cc. would suffice for "gas" production in gelatine "shake" cultures in 24 hours at 20° C., and that $\frac{1}{100000}$ to $\frac{1}{1000000}$ cc. would be capable of giving rise to indol in broth cultures within five days at 37° C.

Further samples of soil were collected on the following dates:—February 4, 11, 18, 25; March 4, 11, 18, 25; and April 13, 22:

* Before application to the soil, the sewage was allowed to stand in Winchester quart bottles for a quarter of an hour, to allow the grosser particles to settle. The sediment was not put on the soil.

Namely, 5, 12, 19, 26, 33, 40, 47, 54, 73 and 82 days respectively after last inoculation.*

TOTAL NUMBER of bacteria and spores of aerobic bacteria.—In this series no special records were kept under this heading.

"*GAS*" *in gelatine* "*shake*" *cultures* (24 hours at 20° C.).—The results are shown in Table XX.

TABLE XX.

Showing as regards "GAS" in gelatine "shake" cultures (24 hours at 24° C.), the results of the Bacteriological Examination of Soils I., II., III., IV., V., VI., VII., VIII., IX., X., XI., XII., XIII., XIV., XV.

[Part II., Series A.]

Description of the sample of Soil.	"Gas" in gelatine "shake" cultures (24 hours at 20° C.) inoculated with:—		
	0·01 Gramme.	0·001 Gramme.	0·0001 Gramme.
Soil I. December 5th, 1900, collected previous to any inoculation.	-		
Soil II. December 10th, 1900, collected previous to any inoculation.	-		
Soil III. January 4th, 1901, collected previous to inoculation made on January 4th.	+	-	
Soil IV. January 10th, 1901, collected subsequent to inoculation made on January 10th.	+	-	
Soil V. January 30th, 1901, immediately after last inoculation (January 30th).	+	-	
Soil VI. February 4th, 1901, five days after last inoculation.	+	-	
Soil VII. February 11th, 1901, 12 days after last inoculation.	-		
Soil VIII. February 18th, 1901, 19 days after last inoculation.	-		
Soil IX. February 25th, 1901, 26 days after last inoculation.	-		
Soil X. March 4th, 1901, 33 days after last inoculation.	-		
Soil XI. March 11th, 1901, 40 days after last inoculation.	-		
Soil XII. March 18th, 1901, 47 days after last inoculation	-		
Soil XIII. March 25th, 1901, 54 days after last inoculation.	-		
Soil XIV. April 13th, 1901, 73 days after last inoculation.	-		
Soil XV. April 22nd, 1901, 82 days after last inoculation.	-		

* The soil remained moist during the whole period of the investigation.

It is to be noted that whereas Soils I. and II., collected previous to commencement of the inoculations, gave no "gas" with 0·01 gramme, Soil III., collected after the application of 28 litres of sewage to the soil, gave a positive result with this amount. Further, Soil IV., collected after the application of 48 litres, gave a positive result, even with 0·001 gramme. Soils V. and VI., collected respectively immediately after the last inoculation and five days later, gave a positive result with 0·01 gramme. Soils VII. to XV. (both inclusive) all yielded negative results with 0·01 gramme.

These results afford no reasonable grounds for doubting that the gas-forming bacteria of the sewage perished in the soil or at least became greatly reduced in number.

INDOL curve (*indol in broth cultures, 5th day at* 37° C.).—The results are shewn in Table XXI.

TABLE XXI.

Showing as regards INDOL in broth cultures (five days at 37° C.), the results of the Bacteriological Examination of Soils V., VI., VII., VIII., IX., X., XI., XII., XIII., XIV., XV.

[Part II., Series A.]

Description of the sample of Soil.	Indol in broth culture (five days at 37° C.).			
	0·01 Gramme.	0·001 Gramme.	0·0001 Gramme.	0·00001 Gramme.
Soil I. December 5th, 1900, collected previous to any inoculation.	No record.	No record.	No record.	No record.
Soil II. December 10th, 1900, collected previous to any inoculation.	"	"	"	"
Soil III. January 9th, 1901, collected previous to inoculation made on January 4th, 1901.	"	"	"	"
Soil IV. January 10th, 1901, collected subsequent to inoculation made on January 10th, 1901.	"	"	"	"
Soil V. January 30th, 1901, collected immediately after last inoculation (January 30th).	+	+	+	+
Soil VI. February 4th, 1901, collected five days after last inoculation.	+	+	+	+

TABLE XXI.—*continued.*

Description of the sample of Soil.	Indol in broth culture (five days at 37° C.).			
	0·01 Gramme.	0·001 Gramme.	0·0001 Gramme.	0·00001 Gramme.
Soil VII. February 11th, 1901, collected 12 days after last inoculation.	+	+	+	-
Soil VIII. February 18th, 1901, collected 19 days after last inoculation.	+	-	-	-
Soil IX. February 25th, 1901, collected 26 days after last inoculation.	+	+	-	-
Soil X. March 4th, 1901, collected 33 days after last inoculation.	+	+	-	-
Soil XI. March 11th, 1901, collected 40 days after last inoculation.	+	+	-	-
Soil XII. March 18th, 1901, collected 47 days after last inoculation.	+	-	-	-
Soil XIII. March 26th, 1901, collected 54 days after last inoculation.	+	-	-	-
Soil XIV. April 13th, 1901, collected 73 days after last inoculation.	+	+	-	-
Soil XV. April 22nd, 1901, collected 82 days after last inoculation.	+ (trace.)	+ (trace.)	-	-

The table shows that whereas so minute a quantity as 0·00001 gramme was sufficient to produce indol in broth cultures in the case of Soils V. (collected immediately after the last inoculation) and VI. (collected five days later), none of the remaining soils could effect a similar reaction in broth culture unless a much larger amount of soil was used, namely, 0·0001, 0·001, or 0·01 gramme; equivalent secondly to a tenfold, a hundredfold, or a thousandfold increase. Thus, Soil VII. (12th day) gave a positive result with 0·0001 gramme, Soil VIII. (19th day) with 0·01; but Soil IX. (26th day) reverted to the level of Soil VII. Of the remaining six soils, all showed a tenfold or hundredfold decrease in the amount of soil necessary for the reaction, as compared with Soils VII. and IX., and a hundredfold or thousandfold decrease as compared with Soils V. and VI.

There can be no doubt that the general tendency of the indol curve was in a downward direction.

SPORES OF B. ENTERITIDIS SPOROGENES.—The results are shown in Table XXII.

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TABLE XXII.

Showing as regards the number of spores of B. ENTERITIDIS SPOROGENES, the results of the Bacteriological Examination of Soils I., II., III., IV., V., VI., VII., VIII., IX., X., XI., XII., XIII., XIV., XV.

[Part II., Series A.]

Description of the sample.	Number of spores of B. enteritidis sporogenes per gramme of Soil.			
	At least 100.	At least 1,000.	At least 10,000.	At least 100,000.
Soil I. December 5th, 1900, collected previous to any inoculation.	+	+	-	-
Soil II. December 10th, 1900, collected previous to any inoculation.	+	+	-	-
Soil III. January 4th, 1900, collected previous to January 4th inoculation.	+	+	-	-
Soil IV. January 10th, 1901, collected subsequent to January 10th inoculation.	+	+	+	-
Soil V. January 30th, 1901, collected immediately after last inoculation.	+	+	+	-
Soil VI. February 4th, 1901, collected five days after last inoculation.	+	+	+	-
Soil VII. February 11th, 1901, collected 12 days after last inoculation.	+	+	-	-
Soil VIII. February 18th, 1901, collected 19 days after last inoculation.	+	+	-	-
Soil IX. February 25th, 1901, collected 26 days after last inoculation.	+	+	-	-
Soil X. March 4th, 1901, collected 33 days after last inoculation.	+	+	-	-
Soil XI. March 11th, 1901, collected 40 days after last inoculation.	+	+	-	-
Soil XII. March 18th, 1901, collected 47 days after last inoculation.	+	+	-	-
Soil XIII. March 25th, 1901, collected 54 days after last inoculation.	+	+	-	-
Soil XIV. April 13th, 1901, collected 73 days after last inoculation.	+	+	-	-
Soil XV. April 22nd, 1901, collected 82 days after last inoculation.	+	+	-	-

It will be seen that here, as in the case of the country experiments (Part I.), the soil was unfortunately already rich in the spores of B. enteritidis sporogenes. Thus Soils I. and II. collected previous to any inoculation, contained at least 1000 but less than 10,000 spores per gramme. Soils IV., V., VI., collected respectively during the period of inoculation, immediately after the last inoculation, and five days later, all gave similar results, namely, at least

10,000 but less than 100,000 spores. But the remaining nine soils all reverted to the number found in the soil antecedent to any inoculation (at least 1000 but less than 10,000). At first sight it would seem as if the inoculation of the soil had caused a tenfold increase in the number of spores of B. enteritidis sporogenes, and that as early as the 12th day after the last inoculation the *added* spores had disappeared from the soil. But, as I have already indicated, it is difficult to conceive of the possibility of a sporing anaerobe losing ts vitality during a period covered by weeks or even months.

B. COLI (and allied forms).—In this series both surface phenol gelatine plates and broth cultures (followed by plating) were made.

SOIL I.—In surface phenol gelatine plate cultures containing 0·001, 0·0001 and 0·00001 gramme, no coli-like microbes were noted. Plates were also made from broth tubes containing 0·01, 0·001, 0·0001, and 0·00001 gramme. No coli-like microbes were noted in the 0·001 and 0·0001 plates, but from the 0·01 plate microbe 1 was isolated.

SOIL II.—Cultures were made as in Soil I., but no coli-like microbes were observed in any of the plates.

SOIL III.—Cultures were made as in Soil I. Microbe 2 was isolated from 0·0001 gelatine plate, microbe 3 from the 0·001 plate, microbe 4 from the 0·01 plate (following broth culture), microbe 5 from the 0·001 plate (following broth culture). In none of the other plates were any coli-like microbes noted.

SOIL IV.—Cultures as in Soil I. Microbes 6, 7 and 8 were isolated respectively from the 0·0001 primary plate, the 0·00001 primary* plate, and the 0·001 secondary* plate.

SOIL V.—Cultures as in Soil I. Microbes 9 (10 and 11), 12, 13 and 14, isolated respectively from the 0·00001 primary plate, the 0·0001 primary plate, the 0·01, the 0·001, and the 0·0001 secondary plates.

SOIL VI.—Cultures as in Soil I. Microbes 15, 16, 17, 18, 19 and 20 isolated respectively from the 0·001, 0·0001 and 0·00001 primary plates and the 0·01, 0·001 and 0·0001 secondary plates.

SOIL VII.—Cultures as in Soil I. Microbes 21, 22, 23, 24 and 25 isolated respectively from the 0·01 and 0·001 secondary plates and the 0·001, 0·0001 and 0·00001 primary plates.

SOIL VIII.—Cultures as in Soil I. Microbes 26, 27 and 28 isolated respectively from the 0·001 and 0·0001 primary plates and the 0·01 secondary plate.

SOIL IX.—Cultures as in Soil I. Microbes 29, 30, 31, 32, 33 and 34 isolated respectively from the 0·001, 0·0001 and 0·00001 primary plates and the 0·01, 0·001 and 0·0001 secondary plates.

SOIL X.—Cultures as in Soil I. Microbes 35, 36, 37, 38 and 39 isolated respectively from the 0·001, 0·0001 and 0·00001 primary plates and the 0·01 and 0·0001 secondary plates.

SOIL XI.—Cultures as in Soil I. Microbes 40 and 41 isolated respectively from the 0·00001 primary and the 0·01 secondary plates.

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* To avoid repetition it is convenient to speak of the surface phenol gelatine plates as primary, and the plates made from the broth cultures (after 24 to 48 hours at 37° C.) as secondary.

SOIL XII.—Cultures as in Soil I. Microbes 42, 43 and 44 isolated respectively from the 0·001 primary plate and the 0·01 and 0·001 secondary plates.

SOIL XIII.—Cultures as in Soil I. Microbes 45, 46, 47 and 48 isolated respectively from the 0·001, 0·0001 and 0·00001 primary plates and the 0·01 secondary plate.

SOIL XIV.—Cultures as in Soil I. Microbe 49 isolated from the 0·01 secondary plate.

SOIL XV.—Cultures as in Soil I. Microbes 50 and 51 isolated respectively from the 0·001 and 0·0001 primary plates.

These results are set out in Table XXIII.

TABLE XXIII.

Showing the results of the subculture of the COLI-LIKE microbes met with in cultures made from the various samples of Soils I., II., III., IV., V., VI., VII., VIII., IX., X., XI., XII., XIII., XIV., XV. In some cases, in order to strengthen the negative evidence of the absence of B. coli, subcultures were made from colonies bearing only a remote resemblance to B. coli.

[Part II., Series A.]

Microbe.	Source.	Broth: For (a) diffuse cloudiness in 24 hours; and (b) indol test on 5th day at 37° C. (a.)	Broth (b.)	Gelatine "shake" cultures for "gas" formation. 20° C.	Litmus milk: For (a) acidity; and (b) clotting at 37° C. (a.)	Litmus milk (b.)	Remarks.
1	0·01 gramme. Soil I.; collected previous to inoculation, December 5th, 1900.	+	+	+	+	+	This microbe seemed to be typical in all respects. No liquefaction, 30 days.
	In Soil II., collected previous to inoculation (December 10th), no coli-like microbes could be found.						
2	0·0001 gramme. Soil III.; collected previous to the inoculation on the same day, January 4th, 1901.*	+	-	+	?+	-	No liquefaction, 30 days. Litmus milk culture became of a buff tint and was not typical.
3	0·001 „ „	+	-	+	?+	-	„ „ „
4	0·01 „ „ §	?+	-	+	+	+	No liquefaction, 30 days. Broth culture not quite typical.
5	0·001 „ „	?+	-	+	+	+	„ „ „

* Surface phenol (0·05 per cent.) gelatine plate cultures.
§ Phenol (0·05 per cent.) broth cultures (24 to 48 hours at 37° C.) and subsequent plating.

TABLE XXIII.—*continued.*

Microbe.	Source.	Broth: For (a) diffuse cloudiness in 24 hours; and (b) indol test on 5th day at 37° C.		Gelatine "shake" cultures for "gas" formation. 20° C.	Litmus milk: For (a) acidity; and (b) clotting at 37° C.		Remarks.
		(a.)	(b.)		(a.)	(b.)	
6	0·0001 gramme. Soil IV.; collected subsequent to inoculation on the same day, January 14th, 1901.*	?+	-	+	+	-	No liquefaction, 30 days. Broth culture not quite typical.
7	0·00001 " "			-			No "gas," so not studied further.
8	0·001 " " §			-			" " "
9	0·00001 gramme. Soil V.; collected immediately after the last inoculation, January 30th, 1901.*	+	+	+	+	+	No liquefaction, 30 days. This microbe seemed to be typical in all respects.
10	0·0001 " "	+	+	+	+	+	" " "
11	" " "	+	+	+	+	+	" " "
12	0·01 " " §	+	+	+	+	+	" " "
13	0·001 " "	-		-			No "gas," so not studied further.
14	0·0001 " "	+	+	+	+	+	Same remarks as microbe 9.
15	0·001 gramme. Soil VI.; 5 days later, February 4th.*	+	-	+	+	-	No liquefaction, 30 days. No indol and no clot.
16	0·0001 " "	+	-	+	+	-	" " "
17	0·00001 " "			-			No "gas," so not studied further.
18	0·01 " " §	+	-	+	+	+	No liquefaction, 30 days. No indol.
19	0·001 " "	+	-	+	+	-	Same remarks, but no clot.
20	0·0001 " "	+	-	+	?+	-	No liquefaction, 30 days. No indol, no clot, and milk culture atypical.
21	0·01 gramme. Soil VII.; 12 days later, February 11th.§	+	+	+	+	-	No liquefaction, 30 days. No clot, but indol.
22	0·001 " "	+	-	+	+	-	Same remarks, but no indol.

‡ Surface phenol (0·05 per cent.) gelatine plate cultures.
§ Phenol (0·05 per cent.) broth cultures (24 to 48 hours at 37° C.) and subsequent plating.

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TABLE XXIII.—*continued.*

Microbe.	Source.	Broth: For (a) diffuse cloudiness in 24 hours; and (b) indol test on 5th day at 37° C. (a.)	(b.)	Gelatine "shake" cultures, for "gas" formation 20° C	Litmus milk: For (a) acidity; and (b) clotting at 37° C. (a.)	(b.)	Remarks
23	0·001 gramme. Soil VII.; 12 days later, February 11th.*	+	+	+	+	-	Same remarks, as 21.
24	0·0001 " "			-			No "gas," so not studied further.
25	0·00001 " "			-			" " "
26	0·001 gramme. Soil VIII.; 19 days later, February 18th.*			-			No "gas," so not studied further.
27	0·0001 " "			-			" " "
28	0·01 " " §	+	+	+	+	+	No liquefaction, 30 days Seemed to be completely typical.
29	0·01 gramme. Soil IX.; 26 days later, February 25th.*	+	-	+	+ faint.	-	No liquefaction, 30 days. No indol, no clot, and faint acidity.
30	0·0001 " "	+	+	+ slight	?+	-	No liquefaction, 30 days. Indol, but no clot, and atypical growth in milk and feeble "gas" production.
31	0·00001 " "			+			By 3 days, liquefaction, so further study abandoned.
32	0·01 " " §	+	+	+ slight	?+	-	Same remarks as 30.
33	0·001 " "	+	+	+ slight	?+	-	" " "
34	0·0001 " "	+	+	+ slight	?+	-	" " "
35	0·001 gramme. Soil X.; 33 days later, March 10th.*	?+	-	+	+ feeble.	-	No liquefaction, 30 days. No indol and no clot; feeble acidity and atypical growth in broth.
36	0·0001 " "			-			No "gas," so not studied further.
37	0·00001 " "			-			" " "
38	0·01 " " §	+	-	+	+	-	No liquefaction, 30 days. No indol and no clot.
39	0·0001 " "	+	-	+	+	+	No liquefaction, 30 days. No indol, but clot.

* Surface phenol (0·05 per cent.) gelatine plate cultures.
§ Phenol (0·05 per cent.) broth cultures (24 to 48 hours at 37° C.) and subsequent plating.

TABLE XXIII.—*continued.*

Microbe.	Source.	Broth: For (a) diffuse cloudiness in 24 hours; and (b) indol test on 5th day at 37° C. (a.)	(b.)	Gelatine "shake" cultures for "gas" formation, 20° C.	Litmus milk: For (a) acidity; and (b) clotting at 37° C. (a.)	(b.)	Remarks.
40	0·00001 gramme. Soil XI.; 40 days later, March 11th.*			–			No "gas," so not studied further.
41	0·01 " " §			–			" " "
42	0·001 gramme. Soil XII.; 47 days later, March 18th.*			–			No "gas," so not studied further.
43	0·01 " " §	?+	–	+	–	–	No liquefaction, 30 days. No indol, no acid, no clot, and atypical growth in broth.
44	0·001 " "			–			No "gas," so not studied further.
45	0·001 gramme. Soil XIII.; 54 days later, March 25th.*			–			No "gas," so not studied further.
46	0·0001 " "			–			" " "
47	0·00001 " "			–			" " "
48	0·01 " " §	? +	+ slight	+	+	+ weak.	No liquefaction, 30 days. Slight indol and weak clot, and broth culture did not seem quite typical.
49	0·01 gramme. Soil XIV.; 73 days later, April 13th.§			–			No "gas," so further study abandoned.
50	0·001 gramme. Soil XV.; 82 days later. April 22nd.*			–			No "gas," so further study abandoned.
51	0·0001 " "			–			" " " "

* Surface phenol (0·05 per cent.) gelatine plate cultures.
§ Phenol (0·05 per cent.) broth cultures (24 to 48 hours at 37° C.) and subsequent plating.

In considering the results shewn in Table 23 it is necessary to deal with each set of cultures separately as follows :—

(a.) 0·01 *gramme* (*broth cultures, followed by plating*).—It is to be noted that from Soil V., collected immediately after the last inoculation, a microbe (12) was isolated typical in all respects of B. coli. With the exception of Soil VIII. (19th day), no microbe of comparable sort

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could be found in any of the ten samples of soil subsequently examined. But microbes 18 and 21, isolated respectively from Soils VI. (5th day) and VII. (12th day), were seemingly closely related to B. coli although the former failed as regards indol production and the latter as regards clotting of milk. Microbe 32, isolated from Soil IX. (26th day), was somewhat peculiar; it gave a positive response to the indol test, yet was weak in "gas" producing power, gave no clot, and was otherwise atypical in milk culture. Again, microbe 48 (Soil XIII.; 54th day), although responding slightly to the indol test, produced only a weak clot in milk, and the growth in broth was only doubtfully typical. As regards the last two soils, XIV. and XV., from the former a microbe (49) was isolated which gave no "gas" in "shake" cultures, but in the atterl no coli-like microbes could be found. Judging from the examination of these last two samples, B. coli must have disappeared from the soil or at all events have become much reduced in numbers within a period of 82 days. Certainly there can be little doubt that from Soil V. (collected immediately after the last inoculation) onwards until the close of the experiments (and with the sole exception of Soil VIII.) the tendency exhibited was towards a great reduction of the coli species.

(b.) 0·001 *gramme* (*broth cultures and subsequent plating*).—The microbe (13) selected for study from Soil V. was seemingly not happily chosen, for it gave no "gas." Yet in much more dilute cultures from the same soil microbes of typical sort were isolated. From Soils VI. (5th day) and VII. (12th day) microbes 19 and 22 were isolated. These gave "gas," diffuse cloudiness in broth, and acidity in milk culture. They did not, however, yield indol in broth culture or produce clotting of milk. The next soil, VIII. (19th day), yielded no coli-like microbes. From Soil IX. (26th day) a microbe (33) was isolated, which seemed to be identical with the microbe (32), already referred to as having been obtained from 0·01 gramme of the same soil. From this point onwards either no coli-like microbes were encountered or those that were subcultured failed as regards the preliminary "gas" test.

(c.) 0·0001 *gramme* (*broth cultures and subsequent plating*).—From Soil V. (collected immediately after the last inoculation) a microbe (14) was isolated, which responded satisfactorily to all the positive tests for B. coli. In none of the remaining soils was any microbe of comparable sort discoverable. But from Soil IX. a microbe (34) was isolated which resembled very closely microbes 32 and 33 already referred to. From Soil X. (33rd day) a microbe (39) was isolated which failed only as regards the "indol" test. As regards the last five soils, either the broth cultures showed no diffuse cloudiness, or else the plates made from the broth

cultures showing diffuse cloudiness contained no coli-like microbes.

(d.) 0·00001 *gramme (broth cultures and subsequent plating).*—These cultures proved too dilute to allow of any inferences being drawn.

(e.) 0·001 *gramme (surface phenol gelatine plate cultures).*—The plate from Soil V. (collected immediately after the last inoculation) was too crowded for accurate observation. From Soil VI. (5th day) microbe 15 was isolated. This micro-organism, although responding to other positive tests, failed as regards indol and clotting of milk. Microbe 23, isolated from Soil VII. (12th day), was typical in all respects save clotting of milk. Microbe 26 (Soil VIII.; 19th day) gave no "gas." From Soils IX. and X. (26th and 33rd days) microbes 29 and 35 were isolated. The former gave no indol, no clot, and feeble acidity in milk culture. The latter gave similar results, but the growth in broth was doubtfully tpyical. The plate from Soil XI. (40th day) contained too many liquefying colonies to allow of accurate observations being made. As regards the remaining four soils, either no coli-like microbes appeared in the plates or the colonies chosen for subculture gave no "gas" in "shake" culture.

(f.) 0·0001 *gramme (surface phenol gelatine plate cultures).*—From Soil V. (collected immediately after the last inoculation) microbes 10 and 11 were isolated. These gave a positive response to all the tests. In none of the remaining soils were any coli of quite comparable sort discoverable. But in Soil VI. (5th day) a microbe (16) was found answering to all the tests except indol and clotting of milk. Further, from Soil IX. (26th day), a microbe (30) was isolated, which corresponded in its biological character to the microbes already alluded to in connexion with this same sample of soil, namely, micro-organisms 32, 33, and 34. Conceivably these microbes (30, 32, 33, and 34) were the descendants of a stock of B. coli which at one time gave satisfactory response to all the positive tests for this micro-organism, but which during its sojourn in soil had become enfeebled in one or more directions.

(g.) 0·00001 *gramme (surface phenol gelatine plate cultures).*—From Soil V. (collected immediately after the last inoculation) microbe 9 was isolated. This proved typical in all respects. As regards the remaining ten soils, either no coli-like colonies appeared in the plates or those chosen for subculture failed when tested in "shake" culture.

In general summary of these results, it seems reasonable to conclude that B. coli, subsequent to the last inoculation, gradually disappeared from the soil, or at all events became much reduced in numbers. But here, as in Series 1, 2, 3, Part 1, there was

some indication of the prolonged persistence in the soil of certain microbes—microbes not perhaps responding, or only feebly so, to all of a number of positive tests of B. coli, but still seemingly akin to that microbe. Further, in Part 2 (just as in Part 1) there was some evidence of a recrudescence of vitality among the coli-like microbes in the soil during the progress of the experiments. But possibly this seeming return to vitality may have been more apparent than real, and the results obtained are doubtless open to other interpretations.

STREPTOCOCCI.—The following is a brief account of the results obtained in this direction in regard to this Series A :—

SOIL I. } II. } No streptococci could be found in agar cultures at 37° C. (0·001, 0·0001, and 0·00001 gramme)

SOIL III.—Streptococci (1) was isolated from 0·001 gramme (agar at 37° C.), and streptococcus (2) from 0·0001 gramme (gelatine at 20° C.).

SOIL IV.—Streptococci (3) and (4) and microbe (5) were isolated respectively from 0·0001 and 0·00001 gramme (agar at 37° C.). Some difficulty was experienced in coming to a definite conclusion as to the claims of microbe (5) to be considered a streptococcus.

SOIL V.—Streptococci (6) and (7) were isolated respectively from 0·0001, and (8) from 0·00001 gramme (agar at 37° C.).

SOIL VI. VII. VIII. IX. } No streptococci could be found in 0·001, 0·0001, and 0·00001 gramme (surface agar cultures at 37° C.). To test further the negative evidence as to streptococci the minute colonies in the various plates were frequently subcultured. In this way 25 colonies were subjected to more or less attentive study. But the result was wholly negative as regards the presence of streptococci.

SOIL X.—Microbes (9) and (10) were both isolated from 0·001 gramme (agar at 37° C.). Although clearly of peculiar type they could not with certainty be differentiated from the streptococcus class.

SOIL XI.—Microbes (11) and (12) were both isolated from 0·0001 gramme (agar at 37° C.). Although clearly of peculiar type they could not with certainty be differentiated from the streptococcus class.

SOIL XII. XIII. XIV. XV. } No streptococci could be found in 0·001, 0·0001, and 0·00001 gramme (surface agar cultures at 37° C.). Twenty-nine subcultures of the minute colonies occurring in the plates were made, but they all yielded negative results as regards the presence of streptococci.

These results are set out in Table 24, and in Table 25 a brief account is given of the morphological and biological characters of the streptococci isolated.

TABLE XXIV.

Showing, as regards STREPTOCOCCI, the results of the bacteriological examination of Soils I., II., III., IV., V., VI., VII., VIII., IX., X., XI., XII., XIII., XIV., XV.

[Part II., Series A.]

Description of the Experiment.	0·001 Gramme Agar at 37° C.	0·0001 Gramme Agar at 37° C.	0·00001 Gramme Agar at 37° C.
Soil I., collected previous to any inoculation, December 5th, 1900.	-	-	-
Soil II., collected previous to any inoculation, December 10th, 1900.	-	-	-
Soil III., collected during the period of inoculation, but previous to inoculation made on January 4th, 1901.	+*	+†	-
Soil IV., collected during the period of inoculation, and subsequent to inoculation made on January 10th, 1901.		+‖	!+¶
Soil V., collected immediately after the last inoculation, January, 30th, 1901.		+§	+‡
Soil VI., collected five days after last inoculation, February 4th, 1901.	-	-	-
Soil VII., collected 12 days after last inoculation, February 11th, 1901.	-	-	-
Soil VIII., collected 19 days after last inoculation, February 18th, 1901.	-	-	-
Soil IX., collected 26 days after last inoculation, February 25th, 1901.	-	-	-
Soil X., collected 33 days after last inoculation, March 4th, 1901.	!+‖	-	-
Soil XI., collected 40 days after last inoculation, March 11th, 1901.	!+¶¶	-	-
Soil XII., collected 47 days after last inoculation, March 18th, 1901.	-	-	-
Soil XIII., collected 54 days after last inoculation, March 25th, 1901.	-	-	-
Soil XIV., collected 73 days after last inoculation, April 13th, 1901.	-	-	-
Soil XV., collected 82 days after last inoculation, April 22nd, 1901.	-	-	-

* Streptococcus (1).
† " (2), (isolated, however, from a gelatine, not an agar plate).
‖ " (3) and (4).
¶ Microbe (5), (identity doubtful).
§ Streptococci (6) and (7).
‡ " (8).
‖ Microbes (9 and 10) } (identity doubtful).
¶¶ " (11) and (12) }

TABLE XXV.

Showing the chief morphological and biological characters of the STREPTOCOCCI (and microbes of doubtful species), isolated from Soils, III., IV., V., X., and XI.

[Part II., Series A.]

Streptococcus.	Source.	Morphology.	Broth Cultures.	Litmus Milk Cultures.	Remarks.
	As regards Soils I. and II. (collected previous to the inoculation) no streptococci could be found in agar cultures (at 37° C.) containing 0·001, 0·0001 and 0·00001 gramme.				
(1)	0·001 gramme. Soil III., collected during the period of inoculation, but just previous to inoculation made on January 4th, 1901. Agar at 37° C.	Stains well by Gram's method short chains of cocci. Fig. 12, Plate XX.	Diffuse cloudiness. 37° C.	By second day strong acid and solid clot. 37° C.	Mice inoculated subcutaneously from recent broth cultures remained seemingly unaffected.
(2)	0·0001 gramme. Soil III. This streptococcus was isolated from a gelatine, not an agar culture.	Stains well by Gram's method extremely long chains of cocci. Figs. 13 & 14, Plate XX.	Transparent broth and at foot of tube white cloudy growth.	Little or no visible change.	In gelatine streak and plate cultures the growth was like S. longus. No liquefaction of gelatine. Grew better at 20° C. than 37° C.
(3)	0·0001 gramme. Soil IV., collected during the period of inoculation and subsequent to inoculation made on January 10th, 1901. Agar at 37° C.	Short to medium chains of cocci. Fig. 15, Plate XX.	Cloudiness partly diffuse and partly granular in character. 37° C.	Little or no visible change? however, acidity. 37° C.	In gelatine streak culture the colonies tend to remain separate and are minute and transparent looking. No liquefaction.
(4)	" " "	Short to medium chains of cocci. Fig. 16, Plate XXI.	Diffuse cloudiness.	Some acidity, no clot.	" " "
?(5)	0·00001 gramme. Soil IV., collected during the period of inoculation and subsequent to inoculation made on January 10th, 1901. Agar at 37° C.	On the whole seemed to be a streptococcus but no absolute conclusion was arrived at.	" " "	No visible change in two days at 37° C.	The growth in gelatine was suggestive of a streptococcus, the colonies remaining very small and having a transparent look. No liquefaction.

TABLE XXV.—*continued.*

Strepto-coccus.	Source.	Morphology.	Broth Cultures.	Litmus milk Cultures.	Remarks.
(6)	0·0001 gramme. Soil V., collected immediately after the last inoculation, January 30th, 1901. Agar at 37° C.	A streptococcus forming short chains. Fig. 17, Plate XXI.	Diffuse cloudiness. 37° C.	Fairly strong acid, but no clot. 37° C.	The colonies in gelatine grow slowly, are minute in size and are transparent looking. No liquefaction.
(7)	" " "	A streptococcus forming fairly long chains. Fig. 18, Plate XXI.	Clear broth, at foot and sides of tube stringy cirrhus-like growth. 37° C.	" " "	" " "
(8)	0·00001 gramme. Soil V., collected immediately after the last inoculation, January 30th, 1901. Agar at 37° C.	A streptococcus forming extremely long chains. Figs. 19 & 20, Plate XXII.	Transparent broth, at foot of tube cumulus-like growth. 20° C.	Faint acidity, no clot, and whitening of medium near the foot of the tube. 20° C.	Grows both at 37° and 20° C., but best at the lower temperature. No liquefaction of gelatine.
? (9)	0·001 gramme. Soil X., collected 33 days after last inoculation, March 4th, 1901. Agar at 37°C.	Bunches of swollen looking irregularly shaped cells, but also chains of cocci with many elements of distorted shape.	Clear broth, at sides and foot of tube streaky white, very tenacious growth. 20° C.	No change 24 hours' later, whitening at foot of tube and slight acidity but no clot. 20° C.	Grows better at 20°C. than 37°C. In gelatine and agar cultures the growth is more opaque, luxuriant and rapid than is usually the case with streptococci. No liquefaction of gelatine. Identity doubtful.
?(10)	" " "	Long chains of large cocci of very irregular shape.	Transparent broth, at foot of tube viscous white coherent mass. 20° C.	" " "	" " "
?(11)	0·01 gramme. Soil XI., collected 40 days after last inoculation, March 11th, 1901. Agar at 37°C.	In broth culture resembled a short chain streptococcus, in gelatine and agar cultures a minute bacillus simulating a streptococcus.	Diffuse cloudiness. 37° C.	By second day strong acid and solid clot. 37° C.	No liquefaction of gelatine and growth like S. brevis. Microscopic examination of broth cultures led to the belief that it was a streptococcus, but in gelatine and agar cultures the growth was bacillary in character. Identity doubtful.
?(12)	" " "	" " "	" " "	" " "	" " "

It will be noted that no streptococci were found in Soils I. and II. collected antecedent to the inoculation of the soil with London sewage. But in Soils III. and IV., collected during the period of inoculation, and Soil V., collected immediately after the last inoculation, streptococci were found. In Soils VI., VII., VIII., and IX., collected respectively 5, 12, 19, and 26 days after the last inoculation, no streptococci could be found. At this point then it might reasonably have been suspected that either the streptococci had perished in the soil, or had become greatly reduced in numbers. But the next two samples of Soil (X. and XI., 33rd and 40th days) contained microbes which, although peculiar in one or more respects, could not with certainty be distinguished from streptococci. One might indeed have ignored them by reason of their exceptional characters, but the question arises would these same microbes have been rejected if they had occurred under circumstances and conditions known to be favourable to the presence of streptococci, *e.g.*, recent pollution of animal sort. It will be remembered that in previous reports I have always sought to draw inferences as regards streptococci on the basis of dealing with these micro-organisms, not as individuals but as a *class*. And it has been admitted that quite possibly there may be microbes which, although belonging to the streptococcus tribe, may yet stand apart from their neighbours in one or more respects; for example, in the possession of abilities to exist temporarily, if not permanently, under saprophytic conditions. Possibly microbes 9, 10, 11, and 12 are to be thought of in this sense. However this may be, it seems certain that these microbes are not to be considered as wholly comparable to the streptococci isolated during (or immediately after) the period of soil inoculation. As regards Soils XII., XIII., XIV., and XV. no streptococci could be found.

SUMMARY OF SERIES A.

In general summary of the results obtained in Series A (Part II.) the following points seem worthy of note:—

"*Gas*" *in gelatine* "*shake*" *cultures.*—The inoculation of the soil with London sewage led to a material increase in the number of gas-forming bacteria in the soil. Subsequent to the last inoculation a somewhat rapid decrease in their numbers was noted.

Indol curve.—The effect of the continued addition of sewage to the soil was so marked that Samples V. and VI. (collected respectively immediately after the last inoculation and five days later) yielded a positive result with $\frac{1}{100000}$ gramme of soil. Of the remaining nine soils two shewed a ten-fold, four a hundred-fold, and three a thousand-fold decrease. Although the indol curve rose and fell during the progress of the experiments, there could be no question that its general tendency was in a downward direction.

Spores of B. enteritidis sporagenes.—For reasons that have been already dealt with the observations in this direction allow of no definite conclusions.

B. coli.—The experiments judged as a whole pointed to the *relative* disappearance from the soil of coli-like microbes subsequent to the last inoculation. But they also seemed to indicate that some strains of B. coli may retain their vitality in the soil for a considerable period.

Streptococci.—Antecedent to the inoculations no streptococci were found in the soil (Samples I. and II.). During the period of inoculation and immediately afterwards streptococci were found in a minimal quantity of the soil (Samples III., IV., and V.). Shortly afterwards they seemed to have completely perished; but in two of the soils (Samples X. and XI., collected on the 33rd and 40th day) microbes were found which could not with certainty be differentiated from the streptococcus class. Yet they were widely different in character from the streptococci isolated from the earlier samples of soil (Samples III., IV., V.). In the last four soils (Samples XII., XIII., XIV., and XV.) no streptococci were found.

GENERAL SUMMARY AND INFERENCES AS REGARDS SOIL INVESTIGATIONS DURING THE YEAR.

Some hesitation is felt in drawing definite conclusions even after a year's work, because the more fully the subject was gone into the more difficult did it seem to me to be. And this notwithstanding that I was aided by a considerable experience in the bacteriological examination of soils and of sewage. For an increase of knowledge in these matters has more and more impressed me with the desirability of exercising great caution in arriving at conclusions. Nevertheless in certain directions inferences of a possibly useful kind may I think be drawn.

Judging from Series 1 and 2 of Part 1 there was *no indication* that the addition of sewage to a soil leads to a *marked or indeed to other than temporary increase of the sewage microbes in general at the expense of the soil bacteria.* On the contrary, the more hardy soil bacteria seemed to oust the more delicate sewage microbes in the struggle for existence. But more prolonged work in this direction is called for.

Judging from Series 1, 2, 3, Part 1, and Series A, Part II, the addition of sewage to a soil leads to an increase in the number of "*gas-forming bacteria.* But sometimes rapidly, sometimes more slowly, this increase wholly or in great measure disappears. Occasionally a seeming recrudescence of vitality of the gas-forming bacteria takes place.

Judging from Series 3, Part 1, and Series A, Part II, the addition of sewage to a soil leads to an increase in the number of *indol-producing bacteria.* This increase however tends to be soon lost or only maintained in a diminished degree. Periods of seeming recrudescence of vitality among these indol-producing bacteria would seem to be indicated.

Judging from Series 1, 2, 3, Part 1, and Series A, Part II, the addition of sewage to a soil does not always lead to as great an

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It will be noted that no streptococci were found in Soils I. and II. collected antecedent to the inoculation of the soil with London sewage. But in Soils III. and IV., collected during the period of inoculation, and Soil V., collected immediately after the last inoculation, streptococci were found. In Soils VI., VII., VIII., and IX., collected respectively 5, 12, 19, and 26 days after the last inoculation, no streptococci could be found. At this point then it might reasonably have been suspected that either the streptococci had perished in the soil, or had become greatly reduced in numbers. But the next two samples of Soil (X. and XI., 33rd and 40th days) contained microbes which, although peculiar in one or more respects, could not with certainty be distinguished from streptococci. One might indeed have ignored them by reason of their exceptional characters, but the question arises would these same microbes have been rejected if they had occurred under circumstances and conditions known to be favourable to the presence of streptococci, *e.g.*, recent pollution of animal sort. It will be remembered that in previous reports I have always sought to draw inferences as regards streptococci on the basis of dealing with these micro-organisms, not as individuals but as a *class*. And it has been admitted that quite possibly there may be microbes which, although belonging to the streptococcus tribe, may yet stand apart from their neighbours in one or more respects; for example, in the possession of abilities to exist temporarily, if not permanently, under saprophytic conditions. Possibly microbes 9, 10, 11, and 12 are to be thought of in this sense. However this may be, it seems certain that these microbes are not to be considered as wholly comparable to the streptococci isolated during (or immediately after) the period of soil inoculation. As regards Soils XII., XIII., XIV., and XV. no streptococci could be found.

Summary of Series A.

In general summary of the results obtained in Series A (Part II.) the following points seem worthy of note:—

"*Gas*" *in gelatine* "*shake*" *cultures*.—The inoculation of the soil with London sewage led to a material increase in the number of gas-forming bacteria in the soil. Subsequent to the last inoculation a somewhat rapid decrease in their numbers was noted.

Indol curve.—The effect of the continued addition of sewage to the soil was so marked that Samples V. and VI. (collected respectively immediately after the last inoculation and five days later) yielded a positive result with $\frac{1}{100000}$ gramme of soil. Of the remaining nine soils two shewed a ten-fold, four a hundred-fold, and three a thousand-fold decrease. Although the indol curve rose and fell during the progress of the experiments, there could be no question that its general tendency was in a downward direction.

Spores of B. enteritidis sporagenes.—For reasons that have been already dealt with the observations in this direction allow of no definite conclusions.

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General Summary and Inferences as regards Soil Investigations during the Year.

Some hesitation is felt in drawing definite conclusions even after a year's work, because the more fully the subject was gone into the more difficult did it seem to me to be. And this notwithstanding that I was aided by a considerable experience in the bacteriological examination of soils and of sewage. For an increase of knowledge in these matters has more and more impressed me with the desirability of exercising great caution in arriving at conclusions. Nevertheless in certain directions inferences of a possibly useful kind may I think be drawn.

Judging from Series 1 and 2 of Part 1 there was *no indication* that the addition of sewage to a soil leads to a *marked or indeed to other than temporary increase of the sewage microbes in general at the expense of the soil bacteria.* On the contrary, the more hardy soil bacteria seemed to oust the more delicate sewage microbes in the struggle for existence. But more prolonged work in this direction is called for.

Judging from Series 1, 2, 3, Part 1, and Series A, Part II, the addition of sewage to a soil leads to an increase in the number of "*gas-forming bacteria.* But sometimes rapidly, sometimes more slowly, this increase wholly or in great measure disappears. Occasionally a seeming recrudescence of vitality of the gas-forming bacteria takes place.

Judging from Series 3, Part 1, and Series A, Part II, the addition of sewage to a soil leads to an increase in the number of *indol-producing bacteria.* This increase however tends to be soon lost or only maintained in a diminished degree. Periods of seeming recrudescence of vitality among these indol-producing bacteria would seem to be indicated.

Judging from Series 1, 2, 3, Part 1, and Series A, Part II, the addition of sewage to a soil does not always lead to as great an

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increase in the number of *spores of B. enteritidis sporogenes* as might have been anticipated. But the results obtained in this direction are inconclusive, and to some extent even contradictory. The soils of experiment were already rich in the spores of this anaerobe, and further and more prolonged work seems called for with soils of diverse characters before useful conclusions can be drawn. *Prima facie* it might be contended that the spores of an anaerobe would neither multiply nor diminish in the surface layers of soil, but remain as a record of past pollution during a period of months or even years. To some extent these experiments confirmed this view, but sometimes the results seemed to indicate a partial disappearance of the spores B. enteritidis sporogenes from the soil. In connection with each Series certain inferences have been noted under this heading, and it does not seem to me advisable to supplement these with any further statement.

Judging from Series 1, 2, 3, Part 1, and Series A, part II, the addition of sewage to a soil greatly alters its bacterial composition in respect of *B. coli and allied forms.* But this alteration tends to become less and less apparent as time goes on. Sometimes the relative disappearance of B. coli is rapid, sometimes much more slow, and periods of a seeming return to vitality are not uncommon. Moreover, the total disappearance of microbes seemingly akin to B. coli was by no means always established, even when the period of scrutiny was extended over weeks and even months. But there can be little doubt that the experiments as a whole tend to confirm my previous inferences, namely, that if B. coli does not perish in the surface layers of soil it, at all events, becomes greatly reduced in numbers there; so that its presence in a soil in any number may be taken as affording reasonable grounds for suspecting pollution of *comparatively recent* sort.*

Judging from Series 1, 2, 3, Part 1, and Series A, Part II, the addition of sewage to a soil may be detected by the presence of *streptococci* even in a minimal amount of the soil thus polluted. But their disappearance (relatively if not actually) seems to be extremely rapid. The only apparent exceptions occurred in the case of Series A, Part II. Here microbes were isolated on the 33rd and 40th day (notwithstanding negative results having been obtained on the 5th, 12th, 19th, and 26th day) after the last inoculation, which could not definitely be distinguished from streptococci, albeit they were of a somewhat peculiar type. But even admitting their streptococcus nature and their relation to the polluting material, they did not seem to me to be in any way comparable with the streptococci isolated, and in a less amount of soil, during the period of inoculation of the soil with sewage. Clearly the experiments as a whole went to confirm the views I have previously expressed namely, that the presence of streptococci in a soil points to extremely *recent* contamination

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* It is again worth noting that in Series 3, Part I, B. coli typical in all respects was isolated from 0·01 gramme, and B. coli typical in all respects save indol production was recovered from 0·001 and 0·0001 gramme of soil 4 collected immediately after the last inoculation with sewage. 150 days later a general sample of soil was collected from all the 16 divisions of the plot. From this "mixed" sample B. coli could not be recovered even when as much as 1 gramme of the soil was used for cultivation purposes.

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On the Inoculation of Soil with Sewage; by Dr. Houston.

DIAGRAM 4.

Showing the dimensions, &c., of the box (filled with loam) used for the soil-inoculations (Part II, Series A). The soil was inoculated with 4 litres of London crude sewage on the following dates, namely, December 20, 22, 24, 27, 29, 31, 1900; January 2, 4, 7, 9, 12, 14, 16, 19, 21, 23, 26, 28, 30, 1901. Total amount equal 76 litres.

II	IV	VI	VIII	X	XII	XIV			
I	III	V	VII	IX	XI	XIII	XV		

Dimensions (surface area) = 50″ long, 12″ wide, divided into 20 equal areas 6″ × 5″.

SOIL I.—December 5.	Collected previous to inoculation.
II.—December 10.	Collected previous to inoculation.
III.—January 4.	Collected previous to inoculation on that date.
IV.—January 14.	Collected subsequent to inoculation on that date.
V.—January 30.	Collected subsequent to last inoculation.
VI.—February 4.	Collected 5 days after last inoculation.
VII.—February 11.	Collected 12 days after last inoculation.
VIII.—February 18.	Collected 19 days after last inoculation.
IX.—February 25.	Collected 26 days after last inoculation.
X.—March 4.	Collected 33 days after last inoculation.
XI.—March 11.	Collected 40 days after last inoculation.
XII.—March 18.	Collected 47 days after last inoculation.
XIII.—March 25.	Collected 54 days after last inoculation.
XIV.—April 13.	Collected 73 days after last inoculation.
XV.—April 23.	Collected 82 days after last inoculation.

METEOROLOGICAL OBSERVATIONS at Cotswold, Maldon Road, Wallington, Surrey (within half a mile of the plot of land used for the experiments detailed in Part I. of this report). Height above O.D. 140 ft. Time 9 a.m. Rain gauge 5 in. Height above ground 4 ft. 1 in.

Day of Month.	May, 1900.			June, 1900.			July, 1900.			August, 1900.		
	Shade Max.	Shade Min.	Rain.	Shade Max.	Shade Min.	Rain.	Shade Max.	Shade Min.	Rain.	Shade Max.	Shade Min.	Rain.
	°	°	In	°	°	In.	°	°	In.	°	°	In.
1				52·2	46·3	·25	65·1	55·6	·14	64·6	59·6	·31
2				63·3	47·2	—	62·0	54·0	·32	**71·2**	**55·2**	**·05**
3				68·9	50·1	—	66·5	53·1	·08	66·3	57·7	·50
4				74·1	48·2	—	68·9	51·3	—	65·2	51·2	—
5				63·0	45·3	—	73·9	53·1	—	60·9	48·9	·08
6				73·2	48·2	·02	66·8	57·1	·03	62·9	51·8	·27
7				65·0	53·0	·13	62·2	48·4	—	65·2	52·9	·11
8				66·6	50·5	·02	66·1	41·8	—	63·1	52·3	—
9				72·7	52·4	—	**72·0**	**54·5**	—	60·1	50·8	·28
10				79·8	49·1	—	81·2	51·4	—	62·7	53·2	·07
11				85·8	57·6	—	**81·8**	**53·3**	—	71·7	48·5	—
12				80·9	57·9	·13	77·6	57·6	—	77·8	54·3	—
13				65·3	55·4	—	81·1	56·1*	—	82·1	51·1	—
14				65·3	50·1	·13	73·3	56·3	—	79·8	51·6	—
15				67·9	54·2	·02	79·3	52·1	—	69·0	56·7	—
16				68·1	53·9	—	**90·8**	**57·2**	—	75·1	57·9	—
17				71·0	59·1	—	81·9	59·5	—	82·0	60·1	1·10
18				72·2	49·2	—	82·3	55·6	—	83·3	57·4	—
19				70·9	56·3	·06	89·1	50·6	—	75·1	56·8	—
20	64·1	37·1	—	66·7	54·2	·62	89·8	61·9	—	74·1	54·5	·05
21	63·7	46·5	·08	60·7	52·2	·56	75·1	57·6	—	70·2	55·3	—
22	55·9	53·4	·31	67·5	51·4	·15	80·7	61·5	—	66·8	58·3	·19
23	59·6	48·0	·13	66·2	46·4	—	**83·2**	**66·3**	—	64·7	51·1	·25
24	57·9	47·1	·20	63·9	50·5	·17	81·9	61·2	—	68·1	52·2	—
25	61·9	43·2	—	63·5	52·3	·43	90·3	61·2	—	68·0	47·9	—
26	62·8	39·9	—	62·1	51·8	—	**80·8**	**61·7**	—	67·8	51·2	—
27	68·7	41·5	—	65·1	46·2	—	78·9	57·1	·72	60·2	52·6	·07
28	68·3	52·5	—	65·2	49·5	—	74·4	59·3	—	61·1	54·7	—
29	65·4	44·0	—	71·2	49·2	·19	73·6	57·3	·06	69·6	55·8	—
30	56·8	48·2	—	65·8	53·3	—	73·9	56·6	—	66·8	53·3	—
31	54·9	46·7	·23				76·2	54·9	—	73·4	46·2	·25

The records shown in thicker type correspond to the dates of collection of the various samples of soil.

METEOROLOGICAL OBSERVATIONS at Cotswold, Maldon Road, Wallington, Surrey (within half a mile of the plot of land used for the experiments detailed in Part I. of this report). Height above O.D. 140 ft. Time 9 a.m. Rain gauge 5 in. Height above ground 4 ft. 1 in.—*continued*.

Day of Month.	September, 1900.			October, 1900.			November, 1900.			December, 1900.		
	Shade Max.	Shade Min.	Rain.	Shade Max.	Shade Min.	Rain.	Shade Max.	Shade Min.	Rain.	Shade Max.	Shade Min.	Rain.
	°	°	In.	°	°	In.	°	°	In.	°	°	In.
1	66·9	58·2	·14	**62·8**	**41·2**	—	61·9	54·0	·11	43·3	40·4	·05
2	63·0	51·4	—	63·2	49·5	—	**54·8**	**51·6**	**·02**	42·4	38·7	—
3	61·6	47·5	—	58·8	46·4	—	55·3	50·9	—	54·7	39·8	·05
4	64·1	39·0	—	60·7	39·1	·44	53·2	47·6	·02	54·8	41·3	·10
5	69·4	41·1	—	59·9	50·0	·09	56·1	48·3	·03	56·8	49·4	·36
6	72·2	40·4	—	64·7	52·2	—	55·2	50·2	·18	**52·1**	**48·3**	**11**
7	72·9	43·5	—	66·9	57·2	—	50·4	48·2	·19	51·2	37·6	—
8	67·2	49·9	—	**72·2**	**51·5**	—	**53·7**	**40·4**	**·05**	52·2	40·2	—
9	69·4	48·4	—	72·7	57·2	·01	54·6	46·2	—	54·0	50·4	—
10	70·9	47·4	—	58·2	54·2	—	49·4	38·1	—	51·8	40·0	—
11	64·2	43·4	—	**56·8**	**40·3**	—	47·2	24·1	—	53·1	38·3	—
12	68·8	40·2	—	57·9	39·3	—	56·0	33·3	·09	55·7	47·4	·04
13	70·3	40·9	—	56·1	45·5	—	56·9	42·3	·07	**53·2**	**49·6**	**·10**
14	66·9	47·2	—	50·3	42·1	·05	50·9	42·3	·06	50·8	42·1	—
15	70·7	50·2	—	53·1	37·8	—	**53·3**	**40·3**	**·22**	52·1	44·3	·01
16	80·3	56·5	·03	54·3	34·5	·03	47·7	40·8	·39	50·8	40·2	—
17	72·9	55·6	—	63·1	48·1	·01	47·2	42·4	·07	47·6	42·1	—
18	68·7	54·9	·05	**55·4**	**45·9**	**·04**	45·9	41·6	—	50·9	39·0	·29
19	68·0	45·3	—	53·0	45·8	—	43·7	38·6	·01	49·8	36·5	—
20	70·1	39·0	—	48·7	42·2	—	44·1	37·6	·04	53·8	37·1	·13
21	72·3	41·5	—	48·7	35·3	—	44·9	40·5	·02	48·7	43·1	·06
22	69·2	55·8	—	48·4	34·1	·03	**47·1**	**40·8**	—	41·3	32·5	·01
23	73·2	56·7	—	56·8	35·1	·01	48·2	36·0	—	34·9	28·8	—
24	**70·0**	**54·7**	**·08**	57·9	47·3	·05	49·7	30·7	·16	49·1	28·4	·01
25	63·9	42·4	—	**56·4**	**52·0**	**·06**	52·6	39·0	—	51·7	32·5	·01
26	**65·8**	**46·6**	**·02**	49·1	44·2	·21	51·2	40·5	·05	51·5	46·9	·28
27	59·2	56·1	·31	51·9	37·9	·05	51·7	41·6	·05	53·1	44·2	·11
28	63·9	51·2	·02	56·0	39·9	·17	47·8	38·8	·19	46·6	45·3	·06
29	65·9	43·3	—	55·2	47·1	·53	**47·2**	**42·7**	—	46·7	36·0	—
30	61·9	48·3	·15	58·0	46·0	·10	45·0	40·1	·02	52·8	36·4	·71
31				63·7	48·0	·09				43·8	38·2	·05

The records shown in thicker type correspond to the dates of collection of the various samples of soil.

APP. B, No. 4.

On the Inoculation of Soil with Sewage; by Dr. Houston.

METEOROLOGICAL OBSERVATIONS at Cotswold, Maldon Road Wallington, Surrey (within half a mile of the plot of land used for the experiments detailed in Part I of this report). Height above O.D. 140 ft. Time 9 a.m. Rain gauge 5 in. Height above ground 4 ft. 1 in *—continued.*

Day of Month.	January, 1901.			February, 1901.			March, 1901.			April, 1901.			May, 1901.		
	Shade Max.	Shade Min.	Rain.	Shade Max.	Shade Min.	Rain.	Shade Max.	Shade Min.	Rain.	Shade Max.	Shade Min.	Rain.	Shade Max.	Shade Min.	Rain.
	°	°	In.	°	°	In.	°	°	In.	°	°	In.	°	°	In.
1	38·9	36·0	·02	41·5	29·5	—	52·3	38·5	·11	52·2	36·9	—	**62·9**	**34·2**	—
2	45·2	32·4	—	42·9	31·2	—	52·7	37·7	·21	53·3	33·0	·10	53·7	45·3	—
3	38·7	33·4	—	38·9	34·3	—	48·1	38·5	·07	55·9	45·3	·54	65·8	41·3	—
4	41·8	36·4	—	37·0	23·8	·47	53·7	36·4	·17	52·4	41·4	—	57·9	37·4	—
5	36·3	21·2	—	34·8	28·0	·02	**55·2**	**40·0**	**·04**	46·2	34·0	·03	59·6	41·8	—
6	30·7	22·4	·04	36·9	29·9	—	46·7	38·3	·27	55·6	31·5	·09	52·0	40·3	·06
7	**28·6**	**25·1**	**·10**	**41·4**	**30·3**	—	49·5	38·4	·11	59·6	42·1	·03	56·9	41·5	—
8	32·6	22·9	·12	40·3	29·3	—	43·3	36·3	·17	55·7	45·2	·04	53·2	41·5	·05
9	43·3	17·0	—	41·8	34·2	·01	42·2	35·9	—	55·5	42·4	·05	**51·7**	**41·7**	**·69**
10	50·9	30·0	—	41·2	35·2	—	42·7	29·9	—	51·1	38·7	·27	57·1	43·0	·02
11	45·3	38·9	·01	36·9	36·0	—	44·2	30·3	—	52·2	41·6	·38	59·4	39·3	—
12	41·4	31·5	0·1	38·1	24·2	·01	**52·4**	**31·4**	—	48·1	37·4	—	60·4	38·1	—
13	42·9	35·3	—	34·8	26·6	—	40·9	29·2	—	48·9	34·4	·14	62·2	44·1	—
14	47·1	28·1	—	34·7	19·7	·01	44·3	36·3	—	55·7	38·2	·02	**67·8**	**41·9**	—
15	41·7	25·3	·01	34·2	23·4	—	41·7	37·2	·14	50·0	40·5	·17	65·8	41·2	—
16	**47·6**	**29·2**	**·03**	42·8	22·6	·07	43·4	36·7	—	**47·9**	**37·0**	**·13**	57·7	44·0	—
17	48·5	38·3	—	38·6	32·5	·04	47·3	35·9	—	54·8	33·3	—	53·8	41·6	—
18	48·3	38·8	·07	35·8	30·4	0·1	40·8	39·4	—	58·6	41·3	—	61·1	34·1	—
19	48·2	41·2	·20	**33·7**	**29·8**	**·02**	**41·6**	**34·8**	**·26**	61·4	36·4	—	70·2	43·5	—
20	50·2	38·2	—	34·0	30·8	—	39·9	34·2	·28	66·7	39·2	—	**64·8**	**44·1**	—
21	52·3	40·3	—	38·6	25·4	·07	41·6	36·2	—	70·2	47·6	—			
22	49·7	47·2	—	42·9	27·8	—	41·8	31·3	—	70·7	46·5	—			
23	45·9	33·3	—	45·1	36·4	—	41·3	35·4	—	**73·4**	**43·3**	—			
24	47·7	35·5	·05	46·4	38·3	—	40·9	31·1	·02	71·1	45·3	—			
25	47·9	37·6	·02	48·9	38·3	—	36·3	31·5	·02	64·1	43·6	—			
26	51·7	36·3	—	**44·7**	**38·4**	**·34**	**39·1**	**25·9**	**·03**	**54·3**	**44·8**	—			
27	54·2	38·9	·09	47·7	40·3	·03	38·3	25·1	—	51·6	39·4	·02			
28	38·1	35·4	·11	52·2	38·3	·41	38·0	24·1	—	54·3	33·2	—			
29	38·9	29·3	—				42·5	24·6	·34	56·3	32·0	—			
30	40·4	31·5	—				47·6	33·1	·49	59·9	36·3	—			
31	35·9	30·2	—				49·3	41·2	·04						

The records shown in thicker type correspond to the dates of collection of the various samples of soil.

No. 5.

REPORT on the NATURE of the ANTAGONISM of the SOIL to the TYPHOID BACILLUS; by Dr. SIDNEY MARTIN, F.R.S.

APP. B, No. 5. On the Nature of the Antagonism of the Soil to the Typhoid Bacillus; by Dr. Martin, F.R.S.

In four previous reports* the conditions under which the typhoid bacillus may grow in one or other kind of soil have been considered. It is not necessary here to repeat all the results attained. Those which are of importance from the point of view of the present year's report are as follows :—

1. In certain virgin soils, consisting chiefly of sand or peat, and which have never been cultivated, the typhoid bacillus does not grow nor live under any condition of the soil, sterilised or unsterilised.

2. If these virgin soils are placed under cultivation, they become capable, when sterilised, of maintaining the typhoid bacillus for a certain limited period.

3. In cultivated soils—*i.e.*, those containing organic matter, that have been sterilised—the bacillus lives for a prolonged period, and spreads through the soil. If, however, the bacillus be added to a cultivated soil, sterilisation of which has been omitted, the micro-organism cannot be obtained from such soil after twelve days or so.

It is evident that the antagonism of the virgin soil to the typhoid bacillus is not of the same nature as that of the cultivated or organically contaminated soil. In the virgin soil there are but few bacteria; moreover, the antagonism of this soil to the bacillus is observed even if the soil be sterilised. This antagonism may, with great probability, be ascribed to the virgin soil being an unsuitable culture medium—not containing organic matter in sufficient quantity, or of a proper nature, to enable the bacillus to live and grow. This is not the case, however, with the cultivated soils, since these furnish, when sterilised, an excellent culture medium for the typhoid bacillus. The antagonism of the natural cultivated soil to the bacillus is to be attributed to some condition other than the composition of the soil. In the last two reports this antagonism of soil to the bacillus was ascribed to the bacteria naturally present in the soil, some of which are putrefactive, and all of which multiply, to a very great extent, when the soil is moistened and kept warm. It was shown indeed (see report 1899-1900) that there were individual bacteria in soil which were capable of beating out the typhoid bacillus from either a liquid medium or a sterilised portion of soil, when the soil bacterium

* Report of the Medical Officer of the Local Government Board, 1896-97, 1897-98, 1898-99, 1899-1900.

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On the Nature of the Antagonism of the Soil to the Typhoid Bacillus: by Dr. Martin, F.R.S.

and the typhoid bacillus were inoculated at one and the same time. The degree of this antagonism varied with individual soil bacteria. In experiments with particular soil bacteria, it was found that the typhoid bacillus got the upper hand, although, in most instances it was the soil bacterium which killed the typhoid bacillus.

The nature of this observed antagonism of soil bacteria to the typhoid bacillus is the subject of the present report.

The typhoid bacillus cannot live and grow except in the presence of organic matter containing nitrogen. Thus it lives for only a short time in sterilised distilled or tap water. Its vitality is prolonged if peptone be added to the medium. The nature of the antagonism to the typhoid bacillus shown by the soil bacteria may, *a priori*, be due :—

1. To the exhaustion of the nutritive quality of the medium owing to the rapid growth and development of the very numerous soil bacteria; or,

2. To a special antagonism of the chemical products of the soil bacteria to the typhoid bacillus.

In the first case the soil bacteria would usurp all the nutriment at the expense of the typhoid bacillus, so that the latter (being non-spore bearing) would die, while, in the second case, the products of the bacteria would act as poisons to the typhoid bacillus. If antagonistic bodies were formed by the soil bacteria, it is probable that they would be produced either by a chemical transformation of the proteid substances of the medium, or by the excretion by these bacteria themselves of some poisonous substance or substances.

Method of Investigation.

The method of investigation was to separate the aërobic bacteria from a particular sample of soil, and to test their antagonism to the typhoid bacillus. The degree of antagonism of soil bacteria to the typhoid bacillus, as has been shown, varies, but, for the purpose of the present research, no attempt was made to obtain a bacterium of the greatest possible antagonism. The experiments were with two bacteria, both of which eventually caused the disappearance of the typhoid bacillus from the media. Most of the experiments however refer to only one micro-organism, which possessed very characteristic appearances, both microscopically and in culture media.

First Series of Experiments with a single soil bacterium :—

1 Sterilised soil used as a medium; this was inoculated at the same spot with the soil bacterium and with the typhoid bacillus, and the lapse of time observed before the typhoid bacillus disappeared.

2. A liquid medium, consisting of ordinary peptone broth in distilled water to the amount of 5 per cent. This was inoculated with the soil bacterium and with the typhoid bacillus, and observed as before.

3. A liquid medium of ordinary peptone broth: In one series of experiments the soil micro-organism and the typhoid bacillus were added together; in another series, the typhoid bacillus was added first, and allowed to grow for several days before addition of the soil bacterium. The time, in these media, in which the typhoid bacillus disappeared, was determined.

4. The soil bacterium was allowed to grow for certain periods in a liquid medium containing peptone. This medium was then filtered, and the effect on the typhoid bacillus of this filtrate *minus* the bodies of the bacteria was tested.

Most of the experiments were conducted at 37°C.; some were made at 22°C.

Second Series of Experiments.—In these the growth of the typhoid bacillus was tested in the filtrate of liquid media containing peptone after a portion of soil had been added thereto and the liquid incubated for some days at 37°C.

First Series of Experiments with a Single Soil Bacterium.

1. The soil used was a specimen of the garden soil employed in the experiments recorded in last year's report, in which it was shown that the typhoid bacillus would live not longer than twelve days in the unsterilised soil, and this only when such soil contained a small quantity of moisture. Ten or twelve aërobic bacteria were isolated from this soil, and the one chosen for investigation was a very characteristic bacillus, consisting of slender rods, varying in length and forming spores. On the surface of the agar plate, or on the agar slope, the colonies were very characteristic. Whitish or pearl white in colour, they spread in feathery branched masses all over the medium; under a low power of the microscope the spreading colonies were seen in wavy masses, somewhat resembling the spreading colonies of some forms of proteus. In the gelatine plate branching colonies formed, which liquefied the medium in three days. On potato a copious, yellowish diffuse growth was evident in three days. Milk was coagulated in 24 hours, and broth at 37° became turbid, and a thick white scum and deposit formed. No indol reaction was obtained after eight or 21 days' growth. Broth became a dark reddish brown colour on the continued growth of the bacterium, but no putrefactive odour was at any time developed.

No specific name can be given to this bacillus, which resembles, in some of its characteristics, forms of proteus and of B. filamentosus. It will be referred to in the report as B. ramificans.

2. The cultures of the typhoid bacillus, which were used in this investigation, were obtained from the spleens of patients who died of the disease; they were subjected to all the tests, in order to ensure that the growth was pure. From time to time, during the long course of the investigation, these tests were repeated, including the serum reaction. The tests need not be detailed, inasmuch as they were fully considered in last year's report.

Experiment I.—*Antagonism of B. Ramificans to the Typhoid Bacillus in Sterilised Soil.*

The soil used was the Chichester soil, which had been employed for experiments recorded in previous reports. Unsterilised, it was inimical to the typhoid bacillus; sterilised, it served as a good culture medium. Three Erlenmeyer flasks were used, containing soil to the depth of about three-quarters of an inch. Distilled water was added till the soil was just moist, and the flasks were sterilised in the autoclave. They were proved to be sterile by adding a small portion of broth, which was incubated subsequently.

To *flask I.* were added, in the centre of the soil, eleven drops of a broth culture of the *typhoid bacillus*, forty-eight hours old.

To *flask II.* were added 12 drops of a broth culture of *B. ramificans*, six days old.

To *flask III.* were added 12 drops in each instance of the same cultures of the *typhoid bacillus* and of *B. ramificans*. The flasks were placed in the incubator at 37°.

The method of testing for the presence of the bacteria was the same as that described in the last report, namely, taking a portion of the soil, adding it to broth, incubating for 16 to 24 hours, and then brushing the broth over the surface of agar plates. Instead of a camels' hair brush, a brush made of fine platinum wire was used, and was found more convenient.

First testing in 24 hours.—Tested by the above method, flask I. gave, on one agar plate, a pure and copious growth of the typhoid bacillus. Flask II. gave a pure and copious growth of B. ramificans. From flask III. four agar plates were made. Plate I. showed, in 24 hours, a copious growth of B. ramificans, as well as several groups of colonies of the typhoid bacillus. Plate II. showed a moderate growth of B. ramificans, as well as numerous discrete colonies of the typhoid bacillus. Plates III. and IV. showed pure colonies of B. ramificans, and more numerous colonies of the typhoid bacillus. Taking it all in all, therefore, the typhoid bacillus, in 24 hours, was obtained in about the same quantity as B. ramificans.

Second testing in five days.—Flask III. only was tested, four agar plates being made. Three of the plates showed a copious

growth of the B. ramificans, as well as numerous colonies of the typhoid bacillus. In the fourth plate there was only a slight growth of each bacillus. In five days, therefore, there was no tendency of the typhoid bacillus to disappear.

Third testing in 12 *days.*—All three flasks were tested. From flask I. a pure and copious growth of the typhoid bacillus was obtained, and from flask II. a pure and copious growth of the B. ramificans. Four plates were made from flask III., showing a very copious growth of B. ramificans, but also numerous colonies of the typhoid bacillus.

Fourth testing in 18 *days.*—Four plates were made from flask III., each of which showed only a moderate number of colonies of the typhoid bacillus and of B. ramificans.

Fifth testing in 26 *days.*—Four plates were made from flask III., each of which showed a copious growth of B. ramificans, but a much fewer number of colonies of the typhoid bacillus than had been found in the plates from the previous testings.

Sixth testing in 33 *days.*—Four agar plates were made from flask III., each of which showed a copious growth of the B. ramificans, but no colonies of the typhoid bacillus.

The result, therefore, of the experiment showed that B ramificans, in sterile soil, causes a diminution of the typhoid bacillus in about twenty-six days, and beats it out of the field in about thirty-three days. The antagonistic power of the B. ramificans is therefore not as great as that of some of the other soil organisms which had been previously investigated. It did, however, possess antagonistic power, and, being a non-putrefactive bacillus, the investigation of the cause of the antagonism was considered as likely to lead to more interesting results than if it had been a putrefactive micro-organism.

Experiment II.—Antagonism of the B. Ramificans to the Typhoid Bacillus in a Liquid Medium at 22°C.

This experiment, in a liquid medium, was conducted in flasks each containing 200 cc. of distilled water, to which were added 10 cc. of peptone broth.

To *flask I.* 15 drops of broth culture of *B. ramificans* were added, 3 days old.

To *flask II.* was added a similar quantity of broth culture of the *typhoid bacillus*, 4 days old.

To *flask III.* was added a similar quantity of each of the cultures of the *typhoid bacillus* and of *B. ramificans.*

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After inoculation, the flasks were kept in an incubator, at 20° to 22°C.

In such a medium, and at such a temperature, the typhoid bacillus grows but slowly. It does grow, however, and its vitality is not impaired, even after months, as will be seen in the record of the experiment.

First testing in 24 *hours.*—The testing was performed in each instance by brushing the liquid with a platinum brush over the surface of agar plates.

Flask I. gave a pure and copious growth of the B. ramificans; flask II. a pure and moderate growth of the typhoid bacillus. From flask III. three agar plates were made, all of which showed a copious growth of the B. ramificans, but no colonies of the typhoid bacillus.

Second testing in 2 *days.*—Six agar plates were made from flask III., in all of which a pure and copious growth of the B. ramificans was found, but no colonies of the typhoid bacillus.

[It may here be noted that the failure to obtain the typhoid bacillus from a mixture of bacteria, even if six agar plates are used, does not prove that the bacillus is absent, if the testing is only done once. Three or four testings must be performed, using several agar plates, before the absence of the typhoid bacillus can be affirmed. This is shown in the results of several experiments.]

Third testing in 7 *days.*—Flasks I. and II. showed a pure growth, respectively, of the B. ramificans and of the typhoid bacillus. From flask III. six plates were made, three of which showed a pure growth of the B. ramificans. Each of the other three plates showed a growth of the B. ramificans, but also many colonies of the typhoid bacillus. Of particular colonies from two of the plates sub-cultures were made in broth, and subsequently demonstrated to be those of the typhoid bacillus.

Fourth testing in 10 *days.*—Flasks I. and II. still showed growth of the bacilli with which they were inoculated. From flask III. four agar plates were made, two of which showed a pure growth of the B. ramificans; the other two showed numerous colonies of the B. ramificans, but also five or six groups of the typhoid bacillus.

Fifth testing in 14 *days.*—Four plates were made from flask III. Three of these showed a pure growth of B. ramificans. On the fourth plate were about thirty colonies of the typhoid bacillus, which were sub-cultured in broth, and subsequently shown to be this bacillus.

Sixth testing in 21 *days.*—Four plates were made from flask III. All showed a growth of the B. ramificans. In one the growth was pure, but, in the other three, there were isolated colonies of

the typhoid bacillus. At this time, the results of the test appeared to show that the typhoid bacillus was diminishing.

Seventh testing in 45 days.—From flasks I. and II. were obtained a pure and copious growth of the B. ramificans and the typhoid bacillus respectively. Four plates were made from flask III., all of which showed a copious growth of the B. ramificans, but no colonies of the typhoid bacillus.

Eighth testing in 54 days.—Six agar plates were made from flask III. All showed a growth of the B. ramificans, and in four plates the growth was pure. In the remaining two plates there were altogether three colonies of the typhoid bacillus. These were subcultured, and proved to be this bacillus. From the seventh testing it might have been concluded that the typhoid bacillus was absent in flask III. The eighth testing, however, showed that a few bacilli were still left.

Ninth testing in 71 days.—Flasks I. and II. still gave a pure and copious growth of the B. ramificans and of the typhoid bacillus respectively. From flask III. four agar plates were made, all of which showed a copious growth of the B. ramificans, but no colonies of the typhoid bacillus.

Tenth testing in 72 days.—Flasks I. and II. still gave a pure and copious growth of the bacillus they each contained. Five plates were made from flask III., in all of which was a copious growth of the B. ramificans, but no colonies of the typhoid bacillus.

Results.—The results of the experiments are that, in a watery medium, containing 5 per cent. of peptone broth, the B. ramificans is antagonistic to the typhoid bacillus, causing a marked diminution in the quantity in 45 days, and subsequently completely beating it out of the field.

The control flask, containing the typhoid bacillus (flask II.), at the end of the experiment gave a pure culture of the bacillus, which was subjected to all the tests, and gave the characteristic reactions.

Experiment III.—Growth of the Typhoid Bacillus in the Filtrates of the media in which B. Ramificans had grown for 73 days.

Flasks I. and III. of Experiment II. were filtered through a Chamberland filter at the end of the experiment, that is, after the B. ramificans had been growing for 73 days. About 10 cc. of each filtrate were placed in each of several tubes, and the sterility of the liquids tested by incubating the tubes for 24 hours. A tube of each of the filtrates was then inoculated with a broth culture of the typhoid bacillus, and a control broth tube made at the same time.

First testing in 24 hours.—The testing was done on an agar slope. The control tube showed a copious growth. Agar slope cultures made from the filtrates of flasks I. and III., showed only a few discrete colonies, with a slight turbidity in the water of condensation.

Second testing in 3 days.—A copious growth was obtained from the control tube, but no growth from the filtrates, either of flask I. or III.

Third testing in 6 days.—The same result was obtained as from the last testing.

The experiment showed in regard of filtrates of a culture medium in which the B. ramificans had been growing for a length of time, that this medium had been so changed as to become antagonistic to the typhoid bacillus; with the result that when inoculated into such medium the typhoid bacillus died within three days.

One of the above tubes was re-inoculated with the typhoid bacillus, and a fresh control made, but, although a copious growth was obtained from the control tube in 24 hours and again in 6 days, no growth could on either occasion be obtained from the tube containing the filtrate.

A subsequent experiment was performed, in which the growth of the typhoid bacillus in these filtrates was compared with that of the B. coli communis, and with that of B. enteritidis of Gärtner. The cultures of the typhoid bacillus and of the other two bacilli were especially tested as regards their purity before being used for experiment. The testing of the fate of the bacilli in the filtrates was made in the same way as before; that is, by drawing a portion of the filtrate in a large platinum loop over the surface of a slope agar tube.

First testing in 24 hours.

—	Tube inoculated with typhoid bacillus.	Tube inoculated with bacillus coli communis.	Tube inoculated with bacillus enteritidis Gärtner.
Filtrate of Flask I., experiment II.	—	—	—
Filtrate of Flask III., experiment II.	—	Copious growth	—
Control tube ...	—	Copious growth	—

Second Testing in 4 Days.

—	Tube inoculated with typhoid bacillus.	Tube inoculated with bacillus coli.	Tube inoculated with bacillus Gärtner.
Filtrate of Flask I., experiment II.	Copious growth.	Copious growth.	Copious growth.
Filtrate of Flask III., experiment II.	—	Copious growth.	—
Control tube ...	Copious growth.	Copious growth.	Copious growth.

Third Testing in 7 Days.

—	Tube inoculated with typhoid bacillus.	Tube inoculated with bacillus coli.	Tube inoculated with bacillus Gärtner.
Filtrate of Flask I, experiment II.	No growth.	Copious growth.	No growth.
Filtrate of Flask III., experiment II.	—	Copious growth.	—
Control tube ...	Copious growth.	Copious growth.	Copious growth.

Fourth Testing in 10 Days.

—	Tube inoculated with typhoid bacillus.	Tube inoculated with bacillus coli.	Tube inoculated with bacillus Gärtner.
Filtrate of Flask I., experiment II.	No growth.	Copious growth.	No growth.
Filtrate of Flask III., experiment II.	—	Copious growth.	—
Control tube ...	Copious growth.	Copious growth.	Copious growth.

Subsequent testings of the filtrate of flask I., experiment II., containing the B. coli communis, showed that there was no diminution of the bacillus in 25 days.

While, therefore, the filtrates of the watery broth in which the B. ramificans had grown were distinctly antagonistic to the typhoid bacillus and to Gärtner's bacillus, they did not appear to have any effect on the growth of the B. coli communis; a fact altogether consistent with the well known greater resistance of the B. coli communis.

Experiment IV.—Antagonism of B. ramificans to the Typhoid Bacillus in broth at 37°C., giving the Typhoid Bacillus four days' start therein.

Two flasks were prepared, each containing 50 cc. of peptone broth. Both were inoculated with a broth culture of the typhoid bacillus 30 hours old, and were placed in the incubator at 37°C. Four days later the purity of the growth was tested in each flask, and the growth was found to consist solely of the typhoid bacillus. One flask (flask I.) was now inoculated with 12 drops of a broth culture of the B. ramificans, 4 days old. The other flask (flask II.) served as a control.

First testing in 24 hours.—The testing was carried out in the same way as in the previous experiments, namely, by brushing the liquid over the surface of agar plates.

Three agar plates were made of flask I., and each plate showed a large number of colonies of the typhoid bacillus, and a much smaller number of colonies of the B. ramificans.

Second testing in 3 days.—Three plates were made from flask I., and very numerous colonies of both bacilli were obtained.

Third testing in 7 days.—Six plates were made from flask I. In only two of these plates was there any growth. This consisted chiefly of colonies of the typhoid bacillus, and to a less extent of the B. ramificans. One colony of the typhoid bacillus was cultivated in broth, which was subsequently brushed over an agar plate and found to be a pure culture of this bacillus.

Fourth testing in 14 days.—Six plates were made of flask I. In one plate there was no growth. Each of the other plates showed colonies of the B. ramificans and of the typhoid bacillus. The colonies of the B. ramificans were greatly in excess of those of the typhoid bacillus.

Fifth testing in 37 days.—Five agar plates were made from flask I. Each of these showed a large growth of the B. ramificans, but, in contradistinction to the last testing, only one plate showed

any colonies of the typhoid bacillus. In this plate seven discrete colonies were observed

Sixth testing in 52 *days.*—Flask I. now showed a thick deposit, above which the liquid was dark reddish brown, and almost clear. Flask II. had the appearance of a broth culture of the typhoid bacillus of long standing. There was a deposit, and the broth was very turbid, but showed no appreciable change in colour. From flask II. a pure culture of the typhoid bacillus was obtained. From flask I. six agar plates were made, three of which showed growth of the B. ramificans, but no colonies of the typhoid bacillus. In the three other plates no growth appeared.

Seventh testing in 56 *days.*—Flask II. showed a pure culture of the typhoid bacillus. From flask I. five agar plates were made, in all of which there was growth of the B. ramificans, but no colonies of the typhoid bacillus.

These results show that, in broth at 37°C., even when the typhoid bacillus is given a start, B. ramificans causes its diminution in 37 days, and its disappearance in 52.

The growth in the control flask was subjected to the tests for the typhoid bacillus at the end of the experiment, and was found to be a pure growth of this bacillus.

The contents of flask I. were now filtered through a Chamberland filter, and the filtrate placed in tubes, the sterility of their contents being tested by incubation. This filtrate was then used for testing the vitality of the typhoid bacillus in it, as related in the following experiment.

Experiment V.—Growth of the Typhoid Bacillus in the Filtrate of Experiment IV Aftergrowth therein of B. Ramificans for 67 *days.*

A tube of the filtrate was inoculated with an agar culture of the typhoid bacillus, a control broth tube being made at the same time.

First testing in 24 *hours.*—In the control tube the broth was turbid. In that containing the filtrate the liquid was clear, and showed no apparent growth: And this contrast between the two tubes remained the same during the whole course of the experiment.

Tested on slope agar the control tube gave a copious growth of the typhoid bacillus. From the filtrate of experiment IV. only four small colonies were observed, with some growth in the water of condensation.

Second testing in 2 days.—From the control tube a copious growth was obtained; from the other tube only a slight growth in the water of condensation.

Third testing in 4 days.—The control tube gave a copious and pure growth, but no growth was obtained from the tube containing the filtrate.

Fourth testing in 8 days.—The same result was obtained as in the last testing, a copious growth from the control tube; no growth from the filtrate.

It is thus obvious that the *products* of the B. ramificans are inimical to the growth of the typhoid bacillus; that is, this micro-organism converted in 67 days a favourable culture medium into one hostile to the vitality of the typhoid bacillus. In the following experiment the duration of the growth was only 21 days.

Experiment VI. Growth of the Typhoid Bacillus in Broth in which the B. Ramificans had grown for 21 days.

A flask containing 100 cc. of broth was inoculated from an agar growth of the B. ramificans, and incubated at 37° C. A copious growth occurred, the purity of which was ascertained by cultivation at the end of 21 days, after which the contents of the flask was filtered through a Chamberland filter. The filtrate was placed in tubes, and sterilised in the autoclave twenty minutes. Inoculations on slope agar showed the tubes to be sterile. Two tubes (I. and II.) were now inoculated with a whole agar culture of the typhoid bacillus, and a control tube made at the same time.

First testing in 24 hours.—The control tube gave a copious pure growth of the typhoid bacillus. Tube I. gave a few colonies, and tube II. showed one colony on the slope agar, and a slight growth in the water of condensation.

Second testing in 14 days.—An agar plate was made from each of the tubes. That of the control tube showed a copious and pure growth of the typhoid bacillus. From tubes I. and II. no growth was obtained.

Third testing in 18 days.—Gave the same result.

Fourth testing in 33 days.—Also gave the same result.

Thus: in less than fourteen days living typhoid bacilli which had been introduced in large quantity into the liquids were all of them killed.

At the end of the experiment the tubes were re-inoculated with a fresh broth culture of the typhoid bacillus, and a fresh control was made. These tubes were quite clear, contrasting strongly with the control. The results of this *second inoculation* were as follows :—

First testing in 24 hours.—A copious growth from the control tube, and a moderate growth from tubes I. and II.

Second testing in 5 days.—One plate of each filtrate tube was made, each of which showed very slight growth of the typhoid bacillus.

Third testing in 7 days.—From the control tube a copious and pure growth of the typhoid bacillus was obtained; from tube I. (agar slope) only a moderate growth of discrete colonies, with some turbidity in the water of condensation. From tube II. one colony, with some growth in the water of condensation, was obtained.

Fourth testing in 12 days.—The control tube still gave copious growth of the typhoid bacillus, but from tubes I. and II. no growth was obtained.

The antagonism of this soil micro-organism to the typhoid bacillus, which has been demonstrated in the experiments just described, is no doubt possessed by other soil bacteria. Some experiments were performed with another bacterium, obtained from the same soil, which produced putrefactive decomposition of proteids. It was a sufficiently characteristic bacillus, although it could not be named. On agar it presented a very definite appearance; yellowish, opaque, like porcelain, rapidly growing, with edges which were digitate or heaped up. On potato it gave a yellowish brown moist growth. Milk was coagulated within 48 hours, and then rapidly digested. On gelatine a slow growth formed, which produced slow liquefaction of the medium, and the formation of large bubbles of gas. Two flasks, each containing 100 cc. of peptone broth, were inoculated with this bacillus, and placed in the incubator at 37°C. Flask I. was filtered in 14 days, and flask II. in 39 days. Some of the tubes were sterilised in the autoclave, and some unsterilised so as to ascertain whether heat produced any change in the medium. These tubes were then inoculated with the typhoid bacillus, a control broth tube being made at the same time, and the testing of the tubes proceeded with at regular intervals. The control broth tube showed, during the whole of the experiment, an increasing turbidity and deposit produced by the typhoid bacillus, and in this sense it contrasted strongly with the other tubes, which remained clear, while only a few of them showed any appreciable deposit. Even when the testing showed that living typhoid bacilli were present, this great contrast between the control and the experimental tubes remained. The testings were all done on slope agar, and resulted as follows :—

FLASK I. (BROTH CULTURE OF SOIL BACILLUS.)

Experiment (a).

Days of testing.	Sterilised filtrate.	Unsterilised filtrate.
6 days.	Growth.	Growth.
23 days.	Slight growth.	Moderate growth.
34 days.	Slight growth.	Very slight growth.
44 days.	Very slight growth.	Very slight growth.
64 days.	Slight growth.	Slight growth.
86 days.	No growth.	One colony.

Experiment (b).

Days of testing.	Sterilised filtrate.	Unsterilised filtrate.
24 hours.	Growth.	Growth.
16 days.	Very little growth.	Moderate growth.
27 days.	Moderate growth.	Moderate growth.
37 days.	Moderate growth.	No growth.
57 days.	Moderate growth.	No growth.
79 days.	Very slight growth.	No growth.

Experiment (c).

Days of testing.	Sterilised filtrate.	Unsterilised filtrate.
24 hours.	Growth.	Growth.
7 days.	Moderate growth.	Few Colonies.
18 days.	Moderate growth.	Moderate growth.
37 days.	Copious growth.	Moderate growth.
58 days.	Slight growth.	Slight growth.

In this experiment, not more than an inhibiting power on the growth of the typhoid bacillus was shown; a fact the more evident

in the naked eye appearances of the tubes, which remained quite clear although the control tube showed great turbidity and thick deposit.

No further experiments were performed with this micro-organism.

SECOND SERIES OF EXPERIMENTS.

Instead of using a single soil bacterium, as in the previous series, experiments were now performed by adding small portions of the soil to liquid media, in order to determine what degree of antagonism to the typhoid bacillus was produced in these media by the growth in them of a plurality of soil micro-organisms. Five experiments from this point of view were performed.

Experiment VII.—The effect on the Vitality of the Typhoid Bacillus of Broth in which putrefaction was produced by a variety of Soil Bacteria.

To a flask containing 50 cc. of peptone broth there was added a small portion of Chichester soil. Advanced putrefaction occurred during incubation at 37° C., and the flask was filtered in 12 days. The filtrate was placed in tubes, and its sterility ascertained by testing. One tube of filtrate and a control broth tube were each inoculated from a broth culture of the typhoid bacillus.

First testing in 24 *hours.*—The control tube gave a copious growth on agar slope. From the tube containing the filtrate only a slight growth of the typhoid bacillus occurred in the water of condensation.

Second testing in 3 *days.*—A copious growth was again obtained from the control tube on an agar plate, but from the tube containing the filtrate no growth was obtained.

Third testing in 6 *days.*—Gave the same results.

The filtrate had destroyed the typhoid bacillus in less than three days. The tube was re-inoculated with the typhoid bacillus, and a fresh control also made.

Result of this Second Inoculation.

First testing in 24 *hours.*—A copious growth was obtained from the control tube, but no growth from the tube containing the filtrate.

Second testing in 6 *days.*—Gave the same result.

The result of this experiment clearly shows that the soil micro-organisms collectively rapidly transformed the broth medium, which is highly favourable to the typhoid bacillus, into a medium which was antagonistic to and quickly caused the death of the bacillus.

Experiment VIII.

For such change in the culture medium as that above recorded, one must look to a change in the proteids contained therein. Hence, in another experiment the amount of proteid was diminished, liquids being used as culture media, consisting of 200 c.c. of distilled water, and 10 c.c. of peptone broth. This mixture was almost colourless, having a faint yellow tinge. A small portion of Chichester soil was added to the medium in the flask, which was incubated at 37°C. for 22 days, when it was filtered. At first a great growth of bacteria had occurred, causing putrefaction; but bacterial growth then ceased to a great extent, and, at the time of filtration, there was no putrefactive smell. The filtrate was collected in tubes, and the sterility of the liquid ascertained by agar cultivation. One tube was inoculated with a broth culture of the typhoid bacillus, a control tube being also made.

First testing in 24 hours.—A copious growth was obtained from the control tube, but no growth from the tube containing the filtrate. Subsequent testings in three and six days gave the same result. The tube was then re-inoculated with the typhoid bacillus, and tested in 24 hours and six days. But no growth was obtained.

This then was a liquid which was absolutely fatal to the vitality of the typhoid bacillus.

Another experiment was undertaken to test the vitality of the typhoid bacillus, B. coli communis, and Gärtner's bacillus in this filtrate.

First testing in 4 days.

—	Tube inoculated with typhoid bacillus.	Tube inoculated with bacillus coli.	Tube inoculated with bacillus Gärtner.
Filtrate of experiment VIII.	No growth.	No growth.	Moderate growth.
Control	Copious growth.	Copious growth.	Copious growth.

Second testing in 7 days.

—	Tube inoculated with typhoid bacillus.	Tube inoculated with bacillus coli.	Tube inoculated with bacillus Gärtner.
Filtrate of experiment VIII.	No growth.	No growth.	No growth.
Control	Copious growth.	Copious growth.	Copious growth.

A third testing was made in 10 days, and a similar result obtained.

The filtrate, therefore, was as fatal to the B. coli communis and to the B. Gärtner as to the typhoid bacillus.

Experiment IX.

A similar experiment to the last was performed with the same amount of culture medium of the same composition, and with the same kind of soil. The bacteria were allowed to grow for 13 days, when the putrefactive smell had disappeared. The liquid was now filtered, and the filtrate placed in tubes, and the sterility was ascertained by cultivation. For comparison with this filtrate, two other flasks were made, one containing 200 c.c. of distilled water, and the other 200 c.c. of tap water, both being sterilised. A small portion of soil was added to these flasks, and the bacteria allowed to grow for 21 days, when the liquid was filtered, and placed, like the previous filtrate, in the tubes, their sterility being also ascertained. The object of thus incubating the soil in water was to determine whether the bacteria which grew excreted any substance inimical to the typhoid bacillus. The results which are given in the following table are not conclusive one way or the other.

Separate tubes of each of the above filtrates were inoculated with the typhoid bacillus, with B. coli communis, and with Gärtner's bacillus; and a control tube of similar culture medium was made in each instance.

First testing in 24 hours.

—	Tube inoculated with typhoid bacillus.	Tube inoculated with bacillus coli.	Tube inoculated with bacillus Gärtner.
Filtrate of growth in distilled water for 21 days.	No growth.	Moderate growth.	Moderate growth.
Control	No growth.	No growth.	No growth.
Filtrate of growth in tap water for 21 days.	A few colonies.	Moderate growth.	Six colonies.
Control	Moderate growth.	Moderate growth.	Copious growth.
Filtrate of growth in broth water for 13 days.	Moderate growth.	Moderate growth.	Moderate growth.
Control	Copious growth.	Copious growth.	Copious growth.

Second testing in 4 days.

—	Tube inoculated with typhoid bacillus.	Tube inoculated with bacillus coli.	Tube inoculated with bacillus Gärtner.
Filtrate of growth in distilled water for 21 days.	No growth.	No growth.	No growth.
Control	No growth.	No growth.	No growth.
Filtrate of growth in tap water for 21 days.	No growth.	No growth.	No growth.
Control	No growth.	No growth.	No growth.
Filtrate of growth in broth water for 13 days.	No growth.	No growth.	No growth.
Control	Copious growth.	Copious growth.	Copious growth.

The general conclusions that are to be drawn from experiments VIII. and IX. are that the bacteria in the soil can readily produce, *from proteid bodies*, substances which are inimical to the typhoid bacillus.

Experiment X.

To each of six flasks, containing severally about 50 cc. of peptone broth, a small quantity of Chichester soil was added, and the flasks placed in the incubator at 37°C. A copious growth of bacteria appeared in each flask. Two flasks were filtered at the end of two days; other two at the end of seven days, and the remaining two at the end of 14 days. The filtrates were placed in test tubes, and used for determining their effect on the typhoid bacillus.

Experiment X. (a.)—Filtrate after Two Days' Growth.—One tube (A) was inoculated with the typhoid bacillus; another tube (B) was, after being boiled momentarily, and cooled, inoculated with the typhoid bacillus; a third ordinary broth tube (C) served, after inoculation with the typhoid bacillus, as a control. The growth in these tubes was tested at two days, six days, ten days, and 14 days, after the inoculation. In every instance copious and pure growth of the typhoid bacillus was obtained.

Result.—Two days' putrefaction of peptone broth does not yield a filtrate which is inimical to the growth of the typhoid bacillus.

Experiment X. (b.)—Filtrate after Seven Days' Growth.—This filtrate was tested in the same way as the first filtrate. One tube was unboiled, and one tube was boiled for 30 seconds; and these as well as a broth control were inoculated with the typhoid bacillus. They were all tested in 24 hours. The control tube gave a copious and pure growth, but no growth was obtained from either of the tubes containing the filtrate.

Result.—The experiment shows that, not only does seven days' putrefaction yield a filtrate hostile to the typhoid bacillus, but boiling does not diminish this property of the filtrate.

It was necessary to determine what body, or bodies, in the filtrate, possessed the power of killing the typhoid bacillus. During the process of putrefaction, the peptone present in the broth is decomposed, and at the end of 14 days practically disappears. But the filtrate of peptone broth, after 14 days' putrefaction, gives a precipitate on boiling; showing the presence of some coagulable proteid which was not present in the peptone broth before putrefaction had occurred. The peptone is broken up by putrefaction into very numerous bodies. Some of these are gases; others are foul smelling indol compounds; while others, again, belong to various groups of diamines and ptomaïnes. For testing the effect of the products of putrefaction on the growth of the typhoid bacillus, they were roughly divided into proteid products, and bodies soluble in alcohol, that is an alcoholic extract. These were separated in the following way:—

The clear and sterile filtrate of broth, putrefied in seven to fourteen days by the soil organisms, was evaporated to dryness *in vacuo* at a temperature of 50° to 55° C. When dry, it was extracted for 24 hours with absolute alcohol, and the alcohol decanted. The residue, after washing with fresh alcohol and drying, was dissolved in water, re-precipitated with alcohol, and washed; finally dissolved in water, and dried. This was the proteid part of the liquid, and weighed 0·151 gramme. The alcoholic extract was evaporated to dryness, and re-dissolved in absolute alcohol, leaving the mineral salts behind. The amount obtained was 0·192 gramme. It was free from offensive smell, as all the foul smelling bodies and gases had been removed during the process of distillation.

The effect on the typhoid bacillus of these derivatives of putrefaction was tested as follows:—

Experiment X. (c.)—Diluted broth was used as a culture medium for the bacillus; namely 95 cc. of distilled water, with 5 cc. of peptone broth added. In this culture medium the typhoid bacillus will live and multiply for ten weeks or more. (*See* experiment II.) Five cubic centimetres of this culture medium was placed in each of four test tubes.

(A.) The alcoholic extract (0·192 gramme) was dissolved in 3 cc. of sterilised water. One cc. of this solution was added to one broth tube (A_1); 2 cc. added to another tube (A_2). The percentage of alcoholic extract in (A.) was therefore equal to 1·07, and in (A_2) equal to 1·83.

(B.) The proteid precipitate (0·151 gramme) was dissolved in 1·5 cc. of water, and added to a broth tube (to be termed B), the percentage being 2·32.

The tubes (A_1), (A_2), and (B) were boiled after adding the extracts.

(C.) A control tube was made of broth water alone.

All these tubes were inoculated with the typhoid bacillus from a broth culture.

The first testing was in about eighteen hours and a half; an agar slope subculture from each tube being made. In tubes (B) and (C) a copious and pure growth of the typhoid bacillus was obtained. But no growth whatever was obtained from tubes (A_1) and (A_2). A second testing in forty-seven hours gave a like result.

Experiment X. (*d.*)—After the last experiment was concluded there were added in each instance to tubes (A_1) and (A_2) 1·5 c.c. of a broth culture of the typhoid bacillus two days old, in order to test whether the medium could kill a large quantity of these bacilli. This was found to be the case. On testing the tubes seventy-two hours after inoculation, no growth was obtained, showing that the bacilli were all dead.

Result.—It is therefore quite clear that the property of inhibiting and killing the typhoid bacillus resides in the putrefactive bodies soluble in alcohol, and not in the proteid substances.

Effect of the Filtrates on the Motility of the Typhoid Bacillus.

The liquids which had been found hostile to the typhoid bacillus were now tested as regards their effect on the motility and clumping of the bacillus within 24 hours. But they were shown not to have any effect in this sense. In the testing, equal parts of the filtrate and of a 24 hours old broth culture of the typhoid bacillus were used.

Reactions of Liquids with Typhoid Broth Culture.

First Control.

Actively motile. In two hours slight clumping and aggregation of bacilli at edges.

Filtrate of Flask I., Experiment II.

3.40 p.m. Motile, but congregating at edges.

4.10 „ Still motile.

5.35 „ No true clumping, a few motile bacilli in centre of field; most are lying motionless around edge.

Second Control.

12.13 p.m. Actively motile.
1.0 „ Do. ; some at edge not moving.
1.30 „ Do. ; some at edge not moving.
2.10 „ Motile; more at edges not moving.
24 *hours.* Many still moving; most at edges not moving.

Filtrate of experiment VIII

12.30 p.m. Actively moving.
1.5 „ Do. ; some at edges not moving.
1.30 „ Do. ; very few small clumps.
2.12 „ Moving; very few small clumps.
24 *hours.* Some *typical* clumps in field; few bacilli moving about; many at edge not moving.

Filtrate of Experiment IV.

12.27 p.m. Actively moving.
1.7 „ Many not moving, but collected at edges. No true clumps.
1.27 „ Less active, and some small clumps forming.
2.15 „ Do. do.
24 *hours.* No clumps; many still motile; most not moving.

Filtrate of Experiment VII. (Smells very unpleasantly.)

12.45 p.m. Actively motile.
1.8 „ Do. ; not yet aggregated at edges.
1.27 „ Less active. Few clumps forming.
2.16 „ Moving well. Do.
24 *hours.* Actively motile. No clumps.

Filtrate of Experiment VI.

12.55 p.m. Actively motile.
1.27 „ Do. , but aggregating at edges.
2.17 „ Definite clumps forming. Many bacilli still motile.
24 *hours.* Very motile. No. clumps. Many motionless at edges.

In all the specimens the bacilli had apparently increased in number.

It is evident, therefore, that the liquids do not exert any clumping action on the bacillus, nor do they produce any bacteriolysis within the first 24 hours.

GENERAL SUMMARY of the INVESTIGATION of the GROWTH of the TYPHOID BACILLUS in SOIL.

This investigation has been concerned essentially with the extra-corporeal life of the typhoid bacillus. This bacillus is well known to be disseminated by water and by milk, and as infecting persons through these media. In water it can live, however, only a short while. Milk, on the other hand, forms a good culture medium for the bacillus.

Demand for determining whether soil may serve as a medium in which the bacillus lives and flourishes, has arisen in the fact that the occurrence of cases of enteric fever in certain localities is not, in some instances, explained by the dissemination of infection by means of water or milk, or by ascertainable infection from pre-existing cases.

These three modes of infection being eliminated in a particular instance, it was important to determine whether the surroundings of invaded houses might foster in some way the growth of the bacillus; whether, if the earth about a house be contaminated by typhoid dejecta, and if the bacillus can live for any length of time in the earth, the soil of the particular locality might not serve as a constant, or recurrent, source of infection.

Many different forms of bacteria are found in soil, and they are much more numerous in soils that have been cultivated than in other soil. Some of these bacteria are spore-bearing, and their continued existence in the soil is aided by their spores, since spores can resist dryness and heat, and can germinate when the soil becomes again moist. The typhoid bacillus does not bear spores; and, when it disappears from the culture medium, it dies, having no resting stage. Non-spore bearing pathogenic bacteria, as a rule, require the medium of the animal body for their continued existence, their extra-corporeal life being commonly of short duration. On the other hand, the typhoid bacillus is a micro-organism that multiplies in suitable media with enormous rapidity; it is also motile, and, like the bacillus coli, it is more resistant to the action of certain germicidal substances (*e.g.*, phenol and free hydrochloric acid) than many non-pathogenic bacteria such as occur in water.

The typhoid bacillus requires, for its growth and life, nitrogeneous substances, usually in the form of proteids. In the presence of these substances, which it very slowly exhausts, it will live for very considerable periods. Some of the typhoid bacilli, in

a liquid culture medium, sink to the bottom, partially clump, and to a great extent lose their motility; but there is a constant formation of new bacilli in the upper part of the medium.

The investigations upon which I have been engaged, early showed that certain soils, such as sandy, peaty, and uncultivated soils generally, were inimical to the typhoid bacillus, which not only did not grow in them, but became rapidly motionless, and died. In sterilised, cultivated soils, on the other hand, the bacillus was not only found to live, but to multiply also, and, finally, to pervade all the soil. It was obtained in pure culture therefrom at the end of over twelve months from its first insemination. Such a soil, impregnated with the typhoid bacillus, could be dried till it was capable of being pulverised, and the bacillus nevertheless obtained from it. The bacillus did not, however, live long in this dried soil.

Cultivated soil is distinguished from uncultivated soil by containing on the one hand more nitrogeneous organic matter in the form of nitrates and ammonia, and on the other more partially changed proteid substances, with the nitrogeneous products of the putrefactive decomposition of proteids. When, however, the typhoid bacillus is added to a well moistened (but not sloppy) cultivated soil, it rapidly dies, and is usually not obtainable in two days after being sown in it; and its disappearance appears to be more rapid the higher the temperature. In such a moistened soil, at a temperature of 30°–40° C., there is a rapid growth of the bacteria proper to the soil, and it was found that it is to the antagonism of these soil bacteria that the disappearance of the typhoid bacillus is due. If the cultivated soil is not made very moist when the bacillus is added, this micro-organism can be recovered from the soil up to twelve days after it has been added to it, this being the longest time in the Experiments in which the typhoid bacillus has been regained from any unsterilised cultivated soil.

By numerous experiments I have shown that individual soil bacteria possess the power of causing the disappearance of the typhoid bacillus, not only in liquid media containing peptone broth but in sterilised soil media. In a liquid medium, for instance, it has been shown that, after the typhoid bacillus had been growing for some time, the addition of one or other soil bacterium eventually caused its disappearance. Again, in the liquid medium in which a single soil bacterium had been growing for some time, it was found that the typhoid bacillus would not grow; or, if it had a short period of growth, that it eventually died. The medium which was found most hostile to the typhoid bacillus was a peptone broth which had undergone putrefaction on the addition of a small quantity of cultivated soil. After seven days' growth, and after the removal of the soil bacteria, the addition to the particular medium of the typhoid bacillus—even in large quantities—resulted in the death of the micro-organism.

App. B, No. 5.

On the Nature of the Antagonism of the Soil to the Typhoid Bacillus; by Dr. Martin, F.R.S.

It must not be inferred that the putrefactive bacteria proved hostile to the typhoid bacillus by destroying the nitrogeneous matter, and so exhausting the nutrient medium. This cannot be the sole or even chief explanation; for experiments have shown very definitely that the products of putrefaction soluble in alcohol are very powerful agents in inhibiting the growth and in destroying the vitality of the typhoid bacillus.

As a general result of my investigations it is to be concluded that the typhoid bacillus has commonly only a short existence in the soil; that it is destroyed by the products of the putrefactive bacteria which exist in most cultivated soils.

No. 6.

REPORT on the CHEMICAL and BACTERIOLOGICAL EXAMINATION of CHICHESTER WELL WATER; by DR. A. C. HOUSTON.

APP. B, No. 6.

On the Chemical and Bacteriological Examination of Chichester Well Water; by Dr. Houston.

In last year's report (Appendix B, No. 6) an account was given of the results of the chemical and bacteriological examination of soils obtained from the "fever" and "non-fever" areas at Chichester. The investigation was carried out as a preliminary to determining the viability of the typhoid bacillus in Chichester soil *in sitû*, when added artificially thereto in gross amount; always provided that the comparative examinations of the soils obtained respectively from the fever and non-fever areas clearly indicated that such a research would be likely to yield results of special value. But the results of this preliminary investigation did not point to the fever area soils being widely different in bacterial composition from the soils obtained from the non-fever areas. Moreover, the soils from both the fever and non-fever areas did not seem to differ markedly from soils in the immediate environment of dwellings in other localities, occupied by dwellings of a similar class, elsewhere than at Chichester. Nevertheless, the results obtained in no way proved that soil plays no *rôle* in fostering and localising typhoid fever in Chichester. All that could be said was that the tests employed failed to indicate any constant or striking dissimilarity between the particular samples (necessarily few in number) of surface soil obtained from the fever and non-fever areas. Different results, it was noted, might have been obtained if the deeper layers of soil had been examined, and a prolonged investigation of the quality of sub-soil waters in the fever and non-fever areas might, it was suggested, have yielded important information.

Thus the work of 1899–1900 was preliminary to a larger investigation which has occupied my attention during the year now past.

This investigation was pursued in two directions, and no pains were spared to make the work as complete as possible. Not, indeed, that any claim can be made that the number of samples examined was multiplied to the extent at present so much in vogue. Greatly multiplied records have a use of their own and their value must not be underrated, but it is also to be feared that too often they neither individually nor collectively greatly extend our existing knowledge. However this may be, it was thought better to concentrate attention at Chichester on the study of a moderate number of samples rather than carry out examination less strictly of a greater number.

It has been said that the investigation was pursued in two directions: one of these was directed towards determining (a) *the vitality of sewage microbes in soil* artificially polluted with

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On the Chemical and Bacteriological Examination of Chichester Well Water; by Dr. Houston.

sewage, and the other was a study of (b) *the bacterial composition of Chichester sub-soil water.*

The former subject (a) is dealt with in a separate report in this volume, and although not concerned with Chichester soil, and not carried out at that place, it, nevertheless, has a distinct bearing on the Chichester enquiry. For it will be remembered that Dr. Theodore Thomson, in his report to the Board on enteric fever in Chichester, was led by a process of exclusion to frame the provisional hypothesis that the previously polluted soil of that place might play some *rôle* in fostering the viability and the morbific power of the infective material of typhoid fever, and might account in greater or less measure for its local distribution, undue prevalence, and endemic character. And in my own report of last year I pointed out that useful results might possibly be obtained by the inoculation of soil (not necessarily at Chichester) with B. coli instead of B. typhosus, as a microbe much more easily to be identified in a mixture of soil bacteria of very varied sorts, than the bacillus of enteric fever. Further, it was suggested that sewage might be used for the purpose with great advantage since it contains B. coli in enormous numbers, and is also a potent factor in the dissemination of typhoid fever through water supply. The association of B. coli and B. typhosus in excremental matters, and the greater hardihood of the former, would lead one to believe that if it could be proved that B. coli soon perished in soil, the presumptive evidence in favour of the death of B. typhosus under parallel conditions would be of a strong kind. For the results obtained in this direction reference must be made to the report itself (App. B, No. 4 in this volume), but here it must be stated that the *absolute* disappearance of at all events, microbes seemingly akin to B. coli from soil previously polluted with sewage was by no means always established, even when the soil was kept under observation for weeks and even months. But the *relative* disappearance of B. coli (and closely allied forms) from the polluted soil was usually clearly indicated, and the death of streptococci with decline also in the number of gas-forming and indol-producing bacteria, subsequent to the sewage inoculations of the soil, was also established. Moreover, there was no indication that the sewage microbes of non-sporing kind multiplied and throve in the soil at the expense of the bacteria proper (peculiar, as it were) to the soil itself. On the contrary, the soil bacteria appeared to oust in the struggle for existence the more delicate sewage microbes. But the result obtained by these artificial pollutions with sewage of the soil in one or two places, and by the examination of the *surface* layers only of the contaminated soil must not be focussed too finely on the particular case of Chichester. Dr. Thomson speaks of the "degree of the potential pollution" of the soil at Chichester in its possible relation to the "continued recurrence of serious prevalence of enteric fever," implying that from a variety of circumstances known to be most unfavourable and operating during a prolonged period, the soil of that place had received every oppportunity of acquiring some quality or qualities (conceivably favourable to the vitality and persistence of B. typhosus) distinguishing it from the soils in other localities—soils possibly of otherwise comparable sort, but happily

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removed from the malign influence pertaining in the past at Chichester. Such a quality or qualities might only be acquired in full measure after a period of many years, and by the combined action of various conditions incapable of definition and beyond the reach of artificial imitation. So that when I say that the soil inoculation experiments have a distinct bearing on the Chichester inquiry, my remarks must not be read in too literal a sense. What is really meant is this: That as soil was regarded by Dr. Thomson as possibly an agent in fostering and localising typhoid fever in Chichester, any research bearing on the viability of sewage microbes in soil must be of interest in connection with such an hypothesis; but that my results, when working with a particular soil or soils, must not too hastily be used to support or refute suppositions concerning other soils and other localities, either at Chichester or elsewhere.

As regards study of (b) *the bacterial composition of Chichester sub-soil water*, the following is an account of the work carried out in this direction.

It will be remembered that in last year's report I pointed out that, although my tests failed to indicate any striking or constant dissimilarity between the sorts of bacteria obtained respectively from the fever and non-fever areas, the results might have been different if the deeper layers of soil had been examined, or if a prolonged investigation had been carried out of the quality of the sub-soil water.

The only feasible way of obtaining samples of sub-soil water from a number of different localities in Chichester, was to make use of the wells in the neighbourhood. These are surface wells sunk in the coarse gravel overlying the clay of the London and Reading beds, and they are not constructed in such a manner as to prevent the lateral flow of the sub-soil water through their sides. Indeed, the direction taken by the sub-soil water may be judged of by dropping floats into these wells and watching their slow passage from one side of the well to the other. From Dr. Thomson's report it appears that the range of water level in these wells is from about 8 to 12 feet, and that the water may rise to within 3 feet in some wells to 11 feet in others, and recede to 11 feet in some wells to 19 feet in others, of (or from) the ground surface level at the periods respectively of maximum and minimum sub-soil water levels. Further, these wells are, "by their position and structure, liable, in most instances, to dangerous pollution." And "prior to 1895, all houses in Chichester were either undrained or were drained to cesspools. The present sewerage system of the district was commenced in September, 1893, and was not completed until 1895; the first connection of any house to the sewerage system being made in March of the latter year." Dr. Thomson refers to a local suggestion, "namely, that the sewerage system, while not acting as a direct fever agency, may have brought about the outbreaks of enteric fever in Chichester in 1896, 1897, and 1898, by causing, as result of the necessary excavations, disturbance of soil containing infective material." Dr. Thomson has a difficulty in

accepting such a hypothesis because during the time when trenching was in active progress enteric fever was at a low ebb in Chichester, and the serious outbreak of 1896 occurred about a year after the completion of the work. It must be admitted that this local supposition is, at first sight, an attractive one, in view of the polluted character of the soil, the *coarseness* of the gravel beds, and the "easy flow," if I may so express it, of the sub-soil water. Apart from specific pollution it would be a matter of surprise to me if the bacterial contents of the wells during the period of excavations did not show signs of additional contamination. I have had occasion to examine the water of newly-made wells, and have been struck both by the large total number of bacteria present in the water (resulting probably from the disturbance of the soil) and by the length of time during which the results remain unsatisfactory. Nevertheless, I am far from disputing the correctness of Dr. Thomson's conclusions in this connection. But there is another and more important point to which allusion must be made in connection with the sewerage system. Again, quoting from Dr Thomson's report, it is to be noted "that considerable difficulty has been experienced at the disposal works in dealing with the large volume of sub-soil water which at times finds its way into the sewers. . . . . . . "From the large quantities of sub-soil waters admitted *into* the sewers, as indicated above, some idea may be formed of the amount of sewage which may possibly leak *from* the sewers into the sub-soil when the conditions are favourable. A good deal of patching and repairs have been carried out since the sewers were laid with a view of excluding the sub-soil water. The pipes are stated to have been provided with patent joints; however, it was admitted that in many cases they were laid in flooded trenches, hence the leakages are not to be wondered at."

So that the sewerage system would not seem to have altogether removed the possibility of continued soil pollution. Moreover, it is worthy of note that in November, 1898, Dr. Thomson found that there were over 500 houses not drained to the sewers.

At first sight it might seem, the study of Chichester well water in the sense adopted by me was superfluous if Dr. Thomson's views be accepted as correct. For Dr. Thomson, after a careful consideration of all the facts bearing on the question of rainfall and sub-soil water, the sewerage system and water supply (the shallow domestic wells as well as the public water supply), comes to the conclusion that none of these agencies, either separately or even in conjunction, can be held wholly responsible for the *continued serious prevalence* of enteric fever in Chichester. Be it noted, however, that he in no way suggests that these are factors to be altogether ignored in relation to the disease; he merely notes that the available evidence is not in favour of their being casually associated with the sustained existence of typhoid fever in notable amount in Chichester.* But Dr. Thomson's

* If, unwittingly, I seem to give a dogmatic twist to any of Dr. Thomson's conclusions, I wish it to be understood that such a quality is in marked contrast to the general tenour of his report.

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On the Chemical and Bacteriological Examination of Chichester Well Water; by Dr. Houston.

tentative soil hypothesis is surely one which might easily receive support* from the examination of the well water. For in Chichester the well water is really the sub-soil water, and the quality of the sub-soil water is largely dependent on the general character of the soil through which it passes.† Sub-soil water, indeed, is apt to represent the "washings" of soil more or less perfectly "strained" by percolation through its interstices. Dr. Thomson's report affords abundant proof of previous pollution‡ of the soil, and it seems to me that bacterial evidence of excremental pollution of the well water might be taken not only as a direct explanation of exceptional (accidental, as it were) cases of typhoid fever arising amongst the consumers of such water, but might also be regarded in a broad and general way as evidence of the persistence and viability in the deeper layers of the soil of bacteria of intestinal outcome. Proof in the latter sense would seemingly lend support to Dr. Thomson's hypothesis,§ which, be it noted, while not generally implicating sub-soil water or well water, leaves untouched the question of the link or links connecting the possible morbific quality of the soil with the human individual. From the opposite point of view, could evidence of the bacterial purity of the well waters be taken as refuting Dr. Thomson's conclusions? Certainly not, if for no other reason than that the soil might possess and retain its morbific quality notwithstanding the passage through it of the sub-soil water. Soil, as we know, may act as a very perfect filter, and water may pass through a grossly polluted soil and yet issue from it in a nearly pure condition. But, for reasons already stated, this would seem to be less likely to take place at Chichester than in most places. Evidence, however, of the purity of the well water might be used as an explanation of the comparative immunity from enteric fever enjoyed by the well-water drinkers; or rather to interpret the fact that the well drinkers were not conspicuously affected notwithstanding the general pollution of the soil.

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* Refutation might be very difficult.

† More so, perhaps, at Chichester than most places, for I have already alluded to what has been termed the "easy flow" of the sub-soil water through the *coarse* gravel overlying the clay of the London and Reading beds. I have examined sections of the ground strata in quarries in the neighbourhood, and the deep belt of *coarse* gravel underlying a comparatively shallow layer of humus is very striking. The open nature of this gravelly soil, resting, as it does, on an impermeable stratum, must, I think, allow of the free and easy passage of water through its substance.

‡ Thus, he says, "There would seem to be good reason for belief that the ground on which the more populous parts of Chichester stand is fouled, and has long been fouled, to a considerable extent. . . . For, in addition to the soakage of surface filth into the soil, usual in populous neighbourhoods, Chichester suffers from an additional source of soil pollution in the leaky cesspools and cesspit-privies which, until some three years ago, formed the sole methods of disposal of all its excrementitious matters, and which, even now, remain in the district in considerable amount."

§ There is no note of finality in Dr. Thomson's suppositions. On the contrary, he calls for fuller knowledge (at present lacking) of soil conditions in their relations with fever prevalence, as necessary to afford adequate explanation of features that have characterised the time and place distribution of enteric fever in Chichester, before final conclusions can be drawn.

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It will be remembered that in last year's work an equal number of soils were examined respectively from the "fever" and "non-fever" areas. Such a division was not found possible in the case of the well waters, and a careful inspection of the local conditions* convinced me that the best plan would be to examine all the available pump (closed) wells, irrespective of their situation.† With a single exception the open draw wells were left out of account, and although this greatly limited the number of wells subject to examination, it seemed to be the best course to pursue. For it was found that the open wells, from their situation and the primitive methods in vogue for drawing the water, were most unsatisfactory from the point of view of the proposed investigation. For example, the wells often stood open or were only partially and loosely covered with boards in the yard or garden closely adjoining the kitchen and back premises of the house. And the receptacle for drawing the water was not uncommonly a tin or iron pail used for a variety of purposes besides the collection of water, and was sometimes located in the kitchen, or the scullery, or thrown aside until wanted in any convenient and often most objectionable position. So multiple, indeed, were the chances of accidental external contamination of water in draw wells that it seemed to me they must necessarily mask any intrinsic qualities proper to the water itself.

The following is a summary of the several sections of this report :—

I.—Description of the samples of water with account of the chemical and bacteriological methods adopted in the investigation.

II.—Results of chemical examination of the waters.

(1) Free ammonia.

(2) Albuminoid ammonia.

(3) Oxygen absorbed from permanganate.

(4) Chlorine.

III.—Results of bacteriological examination of the waters.

(1) Total number of bacteria.

(2) "Gas" in gelatine "shake" cultures (24 hours at 20° C.

(3) B. coli (and allied forms) and search for B. typhosus, in—

(a) 0·1 cc.
(b) 10 cc. } Pasteur "filter brushing" method.
(c) 100 cc. }

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* I have again to acknowledge my indebtedness to Mr. Saunders, the city surveyor. His special local knowledge proved most useful, and he devoted much of his valuable time to helping me.

† As a matter of fact, and this is to be regarded as a happy circumstance, most of the samples were derived from "fever areas," and some of them bore a close place relation to recent cases of enteric fever. *See* map accompanying the report.

(*d*) Analysis of the coli-like microbes isolated from the various samples of well water.

(4) Spores of B. enteritidis sporogenes (Klein).

(5) Streptococci.

IV.—General summary of the chemical and bacteriological results.

V.—Final conclusions.

[Tables 1–11 appear throughout the text. A map will be found at the end of the report. In Addendum A, a brief summary of Dr. Lorrain Smith's report on typhoid fever in Belfast, 1898, is given.]

I. DESCRIPTION OF WATER SAMPLES AND OF METHODS ADOPTED FOR THEIR INVESTIGATION.

(*a*) *The samples of well water submitted to chemical and bacteriological examination.*

The following (Table 1) gives a brief description of the various samples :—

TABLE 1.

Description of the Sample.	Date of Collection.	Pump Closed Well or Open Draw Well.	Reputed Fever Area or Non-fever Area.
Sample A^1, 18, High Street ..	October 15th, 1900 ..	Pump closed well	Fever area.
Sample B^1, St. Pancras ..	October 15th, 1900 ..	Open draw well	Non-fever area.
Sample C^1, 10, Oving Road ..	October 22nd, 1900 ..	Pump closed well	Fever area.
Sample D^1, Cattle Market ..	October 22nd, 1900 ..	Pump closed well	Non-fever area.
" D^2, " "	February 26th, 1901..	" " "	" "
Sample E^1, 32, Bognor Road	October 30th, 1900 ..	Pump closed well	Fever area.
Sample F^1, Ettrick Road ..	October 30th, 1900 ..	Pump closed well	Non-fever area.
Sample G^1, 2, North Gate ..	November 5th, 1900	Pump closed well	Fever area.
" G^2, " "	January 14th, 1901 ..	" " "	" "
" G^3, " "	February 12th, 1901	" " "	" "
Sample H^1, 16, St. Pancras ..	November 5th, 1900	Pump closed well	Fever area.
" H^2, " "	January 14th, 1901 ..	" " "	" "
" H^3, " "	February 12th, 1901	" " "	"

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Sample F[1], Ettrick Road ..	October 30th, 1900 ..	Pump closed well	Non-fever area.
Sample G[1], 2, North Gate ..	November 5th, 1900	Pump closed well	Fever area.
" G[2], " "	January 14th, 1901 ..	" " "	" "
" G[3], " "	February 12th, 1901	" " "	" "
Sample H[1], 16, St. Pancras ..	November 5th, 1900	Pump closed well	Fever area.
" H[2], " "	January 14th, 1901 ..	" " "	" "
" H[3], " "	February 12th, 1901	" " "	

TABLE I.—*continued.*

Description of the Sample.	Date of Collection.	Pump Closed Well or Open Draw Well.	Reputed Fever Area or Non-fever Area.
Sample I^1, 26, Chapel Street	November 13th, 1900	Pump closed well	Fever area.
" I^2, " "	December 10th, 1900	" " "	" "
" I^3, " "	February 25th, 1901	" " "	" "
Sample J^1, 94, East Street ..	November 13th, 1900	Pump closed well	Fever area.
" J^2, " "	December 10th, 1900	" " "	" "
Sample K^1, 7, 8, 9, Chapel Street.	November 19th, 1900	Pump closed well	Fever area.
" K^2, " "	November 27th, 1900	" " "	" "
" K^3, " "	March 11th, 1901 ..	" " "	" "
Sample L^1, 52, Victoria Road	November 19th, 1900	Pump closed well	Fever area.
L^2, " "	November 27th, 1900	" " "	" "
" L^3, " "	March 11th, 1901 ..	" " "	" "
Sample M^1, 160, Broyle Road	December 3rd, 1900..	Pump closed well	Fever area.
" M^2, " "	January 21st, 1901 ..	" " "	" "
" M^3, " "	March 25th, 1901 ..	" " "	" "
Sample N^1, 66, North Street..	December 3rd, 1900	Pump closed well	Non-fever area.
" N^2, " "	January 21st, 1901 ..	" " "	" "
" N^3 " "	March 25th, 1901 ..	" " "	" "

It will be noted that thirty samples were examined from fourteen different sources; of these ten were from reputed fever areas and four from non-fever areas. One sample was taken from an open draw well, all the rest were from closed pump wells. Their position is shewn on the map accompanying this report. In the map Dr. Thompson's division of the city of Chichester, into areas ("Somerstown," "Orchard Street and Franklin Place," "Within the old walls," "St. Pancras and the Hornet," and "Portfield") is retained. Further, each house invaded by enteric fever during the period May 28th, 1900, to June 5th, 1901 (both dates inclusive) is indicated by a black spot.

(*b*) *The various methods used in the chemical and bacteriological examination of the samples of water.*

Collection of samples.—Sample B^1 was collected in a specially-constructed apparatus which need not be described here, as this was the only sample obtained from an open draw well. All the rest of the samples were collected in sterile bottles, and the pump was worked for some considerable time before collecting the sample. The waters were examined as soon as possible after collection.

Much stress has been laid on the need for prompt examination of water samples, and with some reason. But it may be questioned whether statements that have been made in this connection are not, some of them, open to charge of exaggeration. Foul waters, waters rich in oxidisable and putrescible animal organic matter, do indeed show on keeping a decided increase in their bacterial contents. But pure waters, and even waters of a moderate degree of purity, are far less conspicuous in this respect. So much is this the case that the capacity or lack of capacity of a water to swell its bacterial population on keeping, might actually be used as a test of its potential harmfulness. Thus waters might be purposely stored for a definite number of hours at a fixed temperature before being examined. Those comparatively free from organic pabulum of assimilable sort would be *relatively* unaffected by such treatment, whereas others rich in unconverted putrescible matter would be apt to reveal their true nature to a marked and exaggerated (and therefore possibly useful) extent on bacterioscopic examination. Or the water might be examined immediately or soon after collection, and afterwards at a later stage, and the percentage increase of bacteria noted. Again, there is the question of storage in ice, which is too easily assumed to be entirely free from any objection. There are many bacteria of harmless sort which flourish abundantly at a very low temperature, and it is by no means inconceivable that storage in ice may allow these microbes to multiply at the expense of other and more important bacteria.

Chemical Examination.

No elaborate chemical analyses were carried out, but all the waters were examined for (*a*) free ammonia, (*b*) albuminoid ammonia, (*c*) oxygen absorbed from permanganate, and (*d*) chlorine. These processes are too well known to merit further consideration. There are other and possibly better methods of chemical analysis which might have been employed, but my chief object in making a chemical examination at all was to obtain some records relating to the amount of organic matter present in the well waters, and to place these side by side with the obviously more important bacteriological data. Moreover, the results obtained by one or another chemical method seem to me to differ but slightly, and the advantage claimed now for one now for another test is almost trivial in character considering the serious intrinsic limitations of chemical investigations in their relation to water supply. At all events, the fact that chemists are by no means in agreement as to the best mode of chemically examining potable waters would seem to indicate that some latitude is permissible in selecting processes for adoption in a particular investigation.

Bacteriological Examination.

All the waters, without exception, were filtered through a sterilised Pasteur filter. The surface of the filter was brushed with a sterile brush, with 10 cc. of sterile water. 1,000 cc. of water were used in each case, so that each cc. of the filter brushing suspension was approximately representative of the bacterial contents of 100 cc. of the original water. This procedure made the work more laborious, but it also made the results more valuable. Comparatively few determinations of this sort may yield more valuable information than a great number carried out under the ordinary conditions of experiment. Direct cultures (*i.e.*, cultivations made directly from the water without previous filtration) were, of course, also made.

Total number of bacteria (gelatine, at 20° C.).—These were made direct from the water in the usual manner.

"*Gas*" *in gelatine* "*shake*" *cultures* (24 hours, at 20° C.).—As a rule, two 10 cc. gelatine tubes were inoculated, the one with 1 cc. (= 100 cc.), the other with 0·1 cc. (= 10 cc.), of the "filter brushing." They were placed in warm water (about 35 to 40° C.) for a few minutes to melt the gelatine; then shaken to mix the contents together; placed in cold water to allow the gelatine to become solid again; and finally placed in the cool incubator (20° C.) for 24 hours. As regards the value of this test a note was given in last year's report on the subject.* But here it may be pointed out that a negative result does not necessarily imply

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* App. B, No. 3, addendum B.

"safety," even when a considerable amount of the water ("filter brushing" method) is added to the gelatine. One reason is that the production of gas is largely dependent on the presence of B. coli and B. proteus and their allies, and that a certain number of these microbes are necessary to produce a visible development of gas in gelatine "shake" culture in a reasonable time. The test may be rendered more delicate by extending the incubation to 48 hours, but for various reasons this is not recommended. The test, indeed, is more valuable in its positive aspects, and in connection with the examination of impure waters and sewage effluents. Speaking from the results of a long series of observations, I may say that usually crude sewage gives a positive result within 24 hours, even with so small an amount as $\frac{1}{1000}$ cc. These well waters, as will be presently seen, usually gave a negative result, even with as much as 100 cc. ("filter-brushing" method.)

B. coli (and closely allied forms), and search for B. typhosus.—Both surface phenol (0·05 per cent.), gelatine plate, and phenol (0·05 per cent.) broth cultures were used. The former were incubated at 20° C. and the latter at 37° C. The broth cultures, after incubation at 37° C. for 24–48 hours were used for making surface phenol (0·05 per cent.) gelatine plate cultures. As regards the amount of water used, this varied; but usually cultures were made containing 0·1 cc. direct, and 0·1 cc. (= 10 cc.) and 1·0 cc. (= 100 cc.) of the "filter brushing." These cultivations, as well as ordinary gelatine plates and surface agar plates, were strictly searched for the presence of B. typhosus. But the results were uniformly negative. Considerably over one hundred microbes were made the subject of more or less attentive study. These were sub-cultured either because they resembled B. coli or B. typhosus, or because, at the particular stage of observation, they could not be said not to be either the one or the other. None of these colonies turned out to be B. typhosus, and some of them showed no sort of kinship to B. coli; but the majority were to be thought of as B. coli, or more or less closely related forms. It was necessary, of course, not only to search for B. typhosus but also for B. coli, because the presence of the latter in any number must be regarded as a danger signal in respect of the former. It was not anticipated, although prolonged search was made to this end, that B. typhosus would be found in the well waters. Its presence, there could only be thought of as likely to be very exceptional, and its numbers, if present, to be extremely small; so that it was the more necessary to fall back upon determination of the presence (and, if present, the relative abundance) or absence (and, if absent, from what amount) of some microbe of intestinal sort (*e.g.*, B. coli) as a means of measuring the degree of potential harmfulness of the well waters. As regards the relative values of gelatine plates and broth cultures, with subsequent plating, I am in some doubt. Unquestionably the gelatine plates enable one to study a large number of different strains of coli-like microbes, whereas the broth cultures tend to "draw out," if I may use such a term, a particular race of B. coli at the expense of all other strains. As regards B. typhosus, it is usually held that as it is likely to be present in very small number, primary gelatine plates are not nearly so valuable as secondary ones (that is, plates made from primary broth cultures). The idea being that B. typhosus multiplies in the broth to an extent allowing of its subsequent isolation from the plates made from the broth culture. This of course is quite true, but as B. coli is always likely to be present as well, and in greater numbers (an initial advantage to this microbe), and as it multiplies at a much greater rate (an inherent advantage possessed by B. coli) than B. typhosus, the especial value to the investigator of the broth method may not be real. And every hour we delay making plates from the broth cultures may actually diminish instead of increasing our chances of finally isolating the B. typhosus; for the reason that while the broth method would undoubtedly lead to an increase in the number of B. typhosus, it might actually diminish them relative to the total number of other microbes also present. However this may be, I made full use of both these methods. As regards agar cultures, my own experience has been that most microbes (and perhaps especially B. coli) grow in a more characteristic fashion in gelatine than in agar cultivations. But this opinion is by no means shared by all bacteriologists. As a matter of fact most of the Chichester waters yielded a very small crop of colonies in the agar cultures, even when 0·1 cc. of the 10 cc. "filter brushing" of 1,000 cc. was employed.

Spores of B. enteritidis sporogenes (Klein).—Sterile milk tubes were inoculated severally with 0·1 cc. (= 10 cc.), 1·0 cc. (= 100 cc.), and 2·0 cc. (= 200 cc.), of a 10 cc. "filter brushing" of 1,000 cc. of the water. After heating to 80° C. for 10 minutes they were placed in wide-mouthed and stoppered tubes containing a

freshly prepared mixture of pyrogallic acid and potassium hydrate solution, and incubated at 37° C. for 48 hours. Preparatory to use the milk tubes were boiled for half an hour and then quickly cooled. This is a very necessary piece of procedure, and it is equally important to extend the time of observation of the milk cultures to 48 hours if the results are negative in 24 hours.

Streptococci.—Surface agar plate cultures, incubated at 37° C., were used. Usually the plates were inoculated with 0·1 cc. (= 10 cc.) of a 10 cc. "filter brushing" of 1,000 cc. The minute colonies were sub-cultured in broth (incubated at 37° C.), and if a microscopic examination of the resulting growth proved satisfactory they were further studied in litmus milk, and other media.

II.—Results of the Chemical Examination of Thirty Samples of Chichester Well Water obtained from Fourteen Different Sources.

The chemical results are given in the following table (Table 2):—

Table 2.

Showing the Results of Chemical Examination of Thirty Samples of Chichester Well Water obtained from fourteen different sources, as regards the amount of Free and Albuminoid Ammonia, Oxygen absorbed from Permanganate, and Chlorine.

[Results stated as parts per 100,000.]

Description of the Sample of Water.	Free Ammonia.	Albuminoid Ammonia.	Oxygen absorbed from Permanganate (4 hours at the room temperature).	Chlorine.	Remarks.
Sample A^1, 18, High Street, October 15th, 1900. Pump closed well. Fever area.	Traces.	0·0064	Traces.	4·1	All the waters were bright and clear and remarkably free from suspended matters.
Sample B^1, St. Pancras, October 15th, 1900. Open draw well. Non-fever area.	Traces.	0·0064	0·015	2·0	
Sample C^1, 10, Oving Road, October 22nd, 1900. Pump closed well. Fever area.*	Traces.	0·006	Traces.	2·7	
Sample D^1, Cattle Market, October 22nd, 1900. Pump closed well. Non-fever area.†	Traces.	0·0056	Traces.	3·2	
Sample D^2, Cattle Market, February 25th, 1901.	„	0·004	„	4·0	
Sample E^1, 32, Bognor Road, October 30th, 1900. Pump closed well. Fever area.	Traces.	0·004	Traces.	2·3	

* Sample C^1 contained 0·32 part of oxidised nitrogen.
† „ D^1 „ 0·72 „ „ „

TABLE 2—*continued.*

Description of the Sample of Water.	Free Ammonia.	Albuminoid Ammonia.	Oxygen absorbed from Permanganate (4 hours at the room temperature.)	Chlorine.	Remarks.
Sample F^1, Ettrick Road, October 30th, 1900. Pump closed well. Non-fever area.	Traces.	0·004	Traces.	2·6	All the waters were bright and clear and remarkably free from suspended matters.
Sample G^1, 2, North Gate, November 5th, 1900. Pump closed well. Fever area.	Traces.	0·0048	Traces	2·1	
Sample G^2, 2, North Gate, January 14th, 1901.	,,	0·004	,,	2·2	
Sample G^3, 2, North Gate, February 12th, 1901.	,,	0·004	,,	2·8	
Sample H^1, 16, St. Pancras, November 5th, 1900. Pump closed well. Fever area.	Traces.	0·0052	Traces.	2·6	
Sample H^2, 16, St. Pancras, January 14th, 1901.	,,	0·004	,,	2·5	
Sample H^3, 16, St. Pancras, February 12th, 1901.	,,	0·0024	,,	2·8	
Sample I^1, 26, Chapel Street, November 13th, 1900. Pump closed well. Fever area.	Traces.	0·0048	Traces.	2·9	
Sample I^2, 26, Chapel Street, December 10th, 1900.	,,	0·0064	0·01	4·5	
Sample I^3, 26, Chapel Street, February 25th, 1901.	,,	0·005	Traces.	3·2	
Sample J^1, 94, East Street, November 13th, 1900. Pump closed well. Fever area.	Traces.	0·0056	Traces.	2·8	
Sample J^2, 94, East Street, December 10th, 1900.	,,	0·0056	0·01	3·4	
Sample K^1, 7, 8, and 9, Chapel Street, November 19th, 1900. Pump closed well. Fever area.	Traces.	0·0048	0·01	5·7	
Sample K^2, 7, 8, and 9, Chapel Street, November 27th, 1900.	,,	0·0056	Traces.	5·6	
Sample K^3, 7, 8, and 9, Chapel Street, March 11th, 1901.	,,	0·004	,,	3·2	
Sample L^1, 52, Victoria Road, November 19th, 1900. Pump closed well. Fever area.	Traces.	0·0032	Traces.	2·3	
Sample L^2, 52, Victoria Road, November 27th, 1900.	,,	0·004	,,	2·3	
Sample L^3, 52, Victoria Road, March 11th, 1901.	,,	0·0027	,,	2·5	

TABLE 2—*continued.*

Description of the Sample of Water.	Free Ammonia.	Albuminoid Ammonia.	Oxygen absorbed from Permanganate (4 hours at the room temperature.)	Chlorine.	Remarks.
Sample M^1, 160, Broyle Road, December 3rd, 1900. Pump closed well. Fever area.	Traces.	0·004	Traces.	5·2	All the waters were bright and clear and remarkably free from suspended matters.
Sample M^2, 160, Broyle Road, January 21st, 1901.	"	0·0056	0·011	7·3	
Sample M^3, 160, Broyle Road, March 25th, 1901.	"	0·0064	0·01	6·2	
Sample N^1, 66, North Street, December 3rd, 1900. Pump closed well. Non-fever area.	Traces.	0·0056	Traces.	2·4	
Sample N^2, 66, North Street, January 21st, 1901.	"	0·0032	"	2·6	
Sample N^3, 66, North Street, March 25th, 1901.	"	0·002	"	2·9	

(1.) *Free ammonia.*—It will be noted that all the samples were conspicuous as regards the relative absence of free ammonia. None indeed contained more than mere traces. Assuming past pollution of the soil to have taken place, oxidation of most of the organic matter must have occurred.

(2.) *Albuminoid ammonia.*—As regards albuminoid ammonia—and adopting the general view that a good drinking water should not contain more than 0·008 parts per 100,000—it will be seen that none of the samples were open to suspicion as judged by this test.

(3.) *Oxygen absorbed from permanganate.*—Practically all the waters yielded no more than mere traces of oxygen absorbed from permanganate, and in some of them it was a question whether the error of experiment did not cover the slight amount noted. None of the waters could be regarded as other than of the highest degree of purity on the basis of this test.

(4.) *Chlorine.*—The chlorine figures were of some interest. Chlorine is of course practically unaffected by its passage through soil; and, although it is difficult to know how much chlorine is derived from the soil itself and how much from animal pollution of the soil, the observed variation in the quantity of chlorine in a particular well at one time as compared with another, and in the different wells (although all were of fairly comparable depth and within measurable distance of each other), must be

regarded as somewhat suspicious. Pure upland waters contain about 1 part, and crude sewage about 10 parts per 100,000 of chlorine,* but as regards wells in general the greatest differences have been noted. Some contain only 1 part, many of them 3 to 6, and a number 10 or more parts per 100,000.† Chemists are by no means agreed on the subject, but perhaps a fair statement would be that *shallow* wells should not contain more than 3·5 parts per 100,000, due regard being paid, however, to the geological nature of the district and its distance from the sea. In the present case no less than eighteen out of the thirty samples of water yielded less than 3 parts chlorine. Assuming merely for the sake of discussion that under 3 parts of chlorine might be regarded as unobjectionable and proper as it were to the soil itself, and not to animal pollution, the chlorine figures of the remaining samples are not devoid of interest. Thus, picking and choosing:—Samples M^1, M^2, and M^3 yielded respectively 5·2, 7·3, and 6·2 parts; and Samples K^1 and K^2 respectively 5·7 and 5·6 parts of chlorine. Now if we tentatively regard this excess of chlorine in the particular samples as due to sewage (taking the chlorine contents of sewage as about 10 parts per 100,000) this would mean a contamination equivalent to no less than 22, 43, 32, 27 and 26 cc. respectively of sewage per 100 cc. of the well waters.

The difference now and again observed in the amount of chlorine in one and the same well at different dates is striking. This might be ascribed to seasonal changes, but it was too pronounced in certain instances to make this a likely explanation. Moreover, some of the wells showed but a slight variation at one time as compared with another. For example, samples L^1, L^2, and L^3 were examined on November 19th and November 27th, 1900, and on March 11th, 1901, yet the figures were nearly the same in each case, viz., 2·3, 2·3, and 2·5. Again, samples H^1, H^2, and H^3 were examined on November 5th, 1900, and January 14th and February 12th, 1901, yet the records showed no wide variation (2·6, 2·5, 2·8). Compare these with I^1, I^2, and I^3, examined November 13th and December 10th, 1900, and February 25th, 1901, the figures being 2·9, 4·5, and 3·2; and K^2 and K^3, examined on November 27th, 1900, and March 11th, 1901, the figures being 5·6 and 3·2; and J^1 and J^2, examined on November 13th and December 10th, 1900, the figures being 2·8 and 3·4.

On the whole the chlorine records would seem to point to the possible presence of localised areas in Chichester more or less habitually polluted, as well as to the occasional accidental, as it were, contamination of the subsoil water.

The chemical results as a whole are suggestive of potential rather than of actual harmfulness of the well waters.

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* Thus sewage may contain only about ten times as much chlorine as a pure drinking water. Compare this with the B. coli test. Pure waters may contain no B. coli in 1 cc., 10 cc., and even 100 cc. Yet in sewage the number is apt to be at least 100,000 per cc.

† 100 cc. of an average sample of well water would contain more chlorine than 90 cc. of a pure upland water + 10 cc. of crude sewage.

III.—RESULTS OF THE BACTERIOLOGICAL EXAMINATION OF THIRTY SAMPLES OF CHICHESTER WELL WATER OBTAINED FROM FOURTEEN DIFFERENT SOURCES.

(1.) *Total number of bacteria* (gelatine at 20° C.). The results obtained are shown in Table 3.

TABLE 3.

Showing as regards total number of bacteria in 1 cc. (gelatine at 20° C.) the results of the bacteriological examination of 30 samples of Chichester well water obtained from 14 different sources.

Description of the Sample of Work.				Total number of bacteria in 1 cc. (gelatine at 20° C.)
Sample A[1], 18, High Street	October 15th, 1900.	Pump closed well.	Fever area	300
Sample B[1], St. Pancras .	October 15th, 1900.	Open draw well.	Non - fever area.	1,900
Sample C[1], 10, Oving Road	October 22nd, 1900.	Pump closed well.	Fever area	170
Sample D[1], Cattle Market	October 22nd, 1900.	Pump closed well.	Non - fever area.	131
„ D[2], „ „	February 25th, 1901.	„ „	„ „	38
Sample E[1], 32, Bognor Road	October 3rd, 1900.	Pump closed well.	Fever area	14
Sample F[1], Ettrick Road ..	October 3rd, 1900.	Pump closed well.	Non - fever area.	12
Sample G[1], 2, North Gate ..	November 5th, 1900.	Pump closed well.	Fever area	40
„ G[2], „ „ ..	January 14th, 1901.	„ „	„ „	7
„ G[3], „ „ ..	February 12th, 1901.	„ „	„ „	8
Sample H[1], 16, St. Pancras	November 5th, 1900.	Pump closed well.	Fever area	13
„ H[2], „ „	January 15th, 1901.	„ „	„ „	4
„ H[3], „ „	February 12th, 1901.	„ „	„ „	10

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TABLE 3—*continued.*

Description of the Sample of Work.				Total number of bacteria in 1 cc. (gelatine at 20° C.).
Sample I^1, 26, Chapel Street,	November 13th 1900.	Pump closed well.	Fever area	338
„ I^2, „ „	December 10th, 1900.	„ „	„ „	9,880
„ I^3, „ „	February 25th, 1901.	„ „	„ „	58
Sample J^1, 94, East Street..	November 13th, 1900.	Pump closed well.	Fever area	180
„ J^2, „ „	December 10th, 1900.	„ „	„ „	15
Sample K^1, 7, 8, 9, Chapel Street.	November 19th, 1900.	Pump closed well.	Fever area	64
„ K^2, „ „	November 27th, 1900.	„ „	„ „	150
„ K^3, „ „	March 11th, 1901.	„ „	„ „	14
Sample L^1, 52, Victoria Road	November 19th, 1900.	Pump closed well.	Fever area	159
„ L^2, „ „	November 27th, 1900.	„ „	„ „	196
„ L^3, „ „	March 11th, 1901.	„ „	„ „	160
Sample M^1, 160, Broyle Road	December 3rd, 1900.	Pump closed well.	Fever area	1,090
„ M^2, „ „	January 21st, 1901.	„ „	„ „	400
„ M^3, „ „	March 25th, 1901.	„ „	„ „	141
Sample N^1, 66, North Street	December 3rd, 1900.	Pump closed well.	Non - fever area.	812
„ N^2, „ „	January 21st. 1901.	„ „	„ „	880
„ N^3, „ „	March 25th, 1901.	„ „	„ „	20

It will be seen from the table that of these 30 samples no fewer than 14 yielded less than 100 microbes per cc. 100 micro-organisms or less in 1 cc. is frequently used as a bacteriological standard of purity, and Koch's opinion is commonly cited in support of it. But Koch's observations have been misapprehended. What Koch really meant was this :—In the case of a grossly polluted river water containing many thousand bacteria per cc., efficiency of filtration might be judged to be reasonably perfect if the number were reduced from many thousands to less

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than 100 per cc. Koch's aim was to establish a practical standard in the case of polluted waters subjected to sand filtration; a standard carrying with it some assurance of relative not absolute safety. There are many upland waters in regions seemingly remote from objectionable contamination which may contain over 200 microbes per cc. But such waters are surely to be thought of as more "safe" than a sewage-polluted river water, even if the filtration be so perfect as to reduce the number of bacteria from 10 or more thousand to 100 or less per cc.*

Some of the samples were remarkably free from bacterial life. For example, samples H^2, G^2, G^3, H^3, F^1, H^1, K^3 (and E^1), and J^2 contained only 4, 7, 8, 10, 12, 13, 14, and 15 microbes per cc. respectively.

Of the 16 samples containing over 100 bacteria per cc., three (B^1, I^2, M^1) contained over 1,000; two (N^1, N^2) between 500 and 1,000; and 11 (A^1, C^1, D^1, I^1, J^1, K^2, L^1, L^2, L^3, M^2, M^3) between 500 and 100.

As regards samples collected from the same source, but on different dates, the figures are of interest. For example, I^2 and I^3 collected on December 10th, 1900, and February 25th, 1901, yielded, respectively, 9,880 and 58 bacteria per cc. And N^2 and N^3, collected on January 21st, 1901, and March 25th, 1901, yielded 880 and 20 microbes in 1 cc. On the other hand, L^1, L^2, L^3, collected on November, 19th, 1900, November 27th, 1900, and March 11th, 1901, contained 159, 196, and 160 micro-organisms per cc.

On the basis of numbers, without any knowledge of the circumstances of the supply, a majority of the samples would have been considered either very pure or sufficiently pure to escape condemnation; a few would have been regarded with suspicion, and a very few with marked disfavour.

As to the sorts of bacteria met with in these cultures, the fluorescent bacteria (liquefying and non liquefying) were, of course, very numerous in the waters. B. arborescens was not uncommonly noted; but both B. mycoides and the granular bacillus of soil were conspicuous by their absence. Even in the plates made from 0·1 cc. of the 10 cc. "filter brushings," of 1,000 cc. of the waters, these microbes were seemingly absent. Yet a reference to my other report in this volume shows how abundant they may be in surface soil (at least 10,000 per gramme). Far be it from me to contend that these microbes are never present in water supply. But that they have a sparse distribution in water, while they are especially and peculiarly abundant in superficial soil, is beyond denial. Their presence in water in any number always points in

* It will presently be noted that some of the well waters contained B. coli, notwithstanding that the total number of bacteria fell far short of 100 per cc. Compare this with the following:—A sample of ice cream recently examined by me contained no B. coli in 100 milligrammes, yet the number of bacteria in this quantity was actually 36,000. And again, a particular well water containing 20,480 microbes per cc., yielded no B. coli at all in the same quantity of the water.

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my experience to *soil disturbance* of one sort or other, *e.g*, flood water.

The microbes of coli-like appearance will be considered in a separate section of this report.

(2.) " *Gas* " *in gelatine* " *shake cultures* " (24 hours at 20° C.).

The results obtained were chiefly of a negative character, they are shown in Table 4.

TABLE 4.

Description of the Sample of Water.				"Gas" in Gelatine shake culture (24 hours at 20° C.)	
				10cc *	100cc.§
Sample A^1, 18, High Street	October 15th, 1900	Pump closed well.	Fever area..	-	+
Sample B^1, St. Pancras ..	October 15th, 1900	Open draw well.	Non - fever area.	-	+
Sample C^1, 10, Oving Road	October 22nd, 1900	Pump closed well.	Fever area ..	-	+
Sample D^1, Cattle Market..	October 22nd, 1900	Pump closed well.	Non - fever area.	-	-
" D^2, " "	February 25th, 1901.	" "	" "		
Sample E^1, 32, Bognor Road	October 30th, 1900	Pump closed well.	Fever area ..	-	-
Sample F^1, Ettrick Road ..	October 30th, 1900	Pump closed well.	Non - fever area.	-	-
Sample G^1, 2, North Gate..	November 5th, 1900.	Pump closed well.	Fever area ..	-	-
" G^2 " "	January 14th, 1901.	" "	" "	-	-
" G^3 " "	February 12th, 1901.	" "	" "	-	-
Sample H^1, 16, St. Pancras	November 5th, 1901.	Pump closed well.	Fever area ..	-	-
" H^2, " "	January 14th, 1901.	" "	" "	-	-
" H^3, " "	February 12th, 1901.	" "	" "	-	-

* 0·1 cc. of a 10 cc. "filter brushing" of 1,000 cc. (= 10 cc. of original water).
§ 1·0 cc. " " " " (= 100 cc. " ").

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TABLE 4—*continued.*

Description of the Sample of Water.				"Gas" in Gelatine shake culture (24 hours at 20° C.) 10cc.*	100cc.§
Sample I[1], 26, Chapel Street	November 13th, 1900.	Pump closed well.	Fever area .	-	+
" I[2], " "	December 10th, 1900.	" "	" "	+¶	+
" I[3], " "	February 25th, 1901.	" "	" "		
Sample J[1], 94, East Street .	November 13th, 1900.	Pump closed well.	Fever area ..	-	-
" J[2], " "	December 10th, 1901.	" "	" ".	-	-
Sample K[1], 7, 8, 9, Chapel Street.	November 19th, 1900.	Pump closed well.	Fever area ..	-	-
" K[2]. " "	November 27th, 1900.	" "	" "	-	-
" K[3], " "	March 11th, 1901	" "	" "	-	-
Sample L[1], 52, Victoria Road	November 19th, 1900.	Pump closed well.	Fever area ..	-	-
" L[2]. " "	November 27th, 1900.	" "	" "	-	+
" L[3], " "	March 11th, 1901	" "	" "	-	-
Sample M[1], 160, Broyle Road	December 3rd, 1900.	Pump closed well.	Fever area ..	+†	+
" M[2]. " "	January 21st, 1901	" "	" "	-	+
" M[3], " "	March 25th, 1901	" "	" "	-	-
Sample N[1], 66, North Street	December 3rd, 1900.	Pump closed well.	Non - fever area.	-	-
" N[2], " "	January 21st, 1901	" "	" "	-	-
" N[3], " "	March 25th, 1901	" "	" "	-	-

* 0·1 cc. of a 10 cc. " filter brushing " of 1,000 cc. (=10 cc. of original water).
§ 1·0 cc. " " " " (=100 cc. " ").
¶ Negative result 1 cc.
† " "

It will be noticed that no less than 22 out of the 30 samples failed to give a positive result, even when the bacterial contents of 100 cc. were added to the gelatine. It is evident, then, that on the basis of this simple test alone an enormous distinction can be drawn between crude sewage and some waters. For, speaking

from a wide experience, $\frac{1}{1000}$ cc. of sewage is usually sufficient to produce a visible development of "gas" in gelatine "shake" cultures (in 24 hours at 20° C.). Of the remaining eight samples, six (A^1, B^1, C^1, I^1, L^2, M^2) gave a positive result with 100 cc., but not with 10cc.; and two (I^1 and M^2) gave a positive result both with the 10 cc. and 100 cc. cultures. This test is, of course, of more value in the case of sewage effluents and impure waters than with potable waters. A negative result must not however be taken as meaning the absolute but only the relative absence of gas-forming bacteria.* And again it must not be interpreted as giving more than an indication of relative "safety." A fair and reasonable statement would, I think, be as follows :— A water giving a positive result with 10 cc., and a negative result with 1 cc., should be regarded as probably impure. A water yielding a positive result with 100 cc., and a negative result with 10 cc., ought to be regarded as of doubtful purity if it be judged on the basis of this test alone. A water giving a negative result with 100 cc. affords evidence of comparative safety for potable purposes. On this basis Samples I^2 and M^1 would be classed as impure; A^1, B^1, C^1, I^1, L^2, M^2, as of doubtful purity; and the rest of the samples as relatively "safe."†

A certain measure of parallelism seems to be traceable between the total number of bacteria and the facts as to "gas" production. But two samples (C^1, L^2) yielded "gas" in shake culture, although the total number of bacteria was by no means excessive; and other two (N^1, N^2) gave a negative result as regards "gas" production, notwithstanding the fact that these same samples contained a large number of micro-organisms. The records are not sufficiently numerous to allow of definite conclusions being drawn, but as far as they go they seem to indicate that the relation between the total number of bacteria and the number of gas-forming microbes is not necessarily a constant one.

The different results as regards "gas" production in the same wells but on different dates is worth noting. For example, I^1, I^2, and I^3, collected on November 13th, 1900, December 10th, 1900, and February 25th, 1901, yielded results respectively as follows :— + 100 cc. − 10 cc.; + 10 cc. − 1 cc.; and − 100 cc. And M^1, M^2, and M^3, collected on December 3rd, 1900, January 21st, 1901, March 25th, 1901, gave the following results :—+ 10 cc. − 1 cc.; + 100 cc. − 10 cc; and − 100 cc.

(3) *B. coli (and closely allied forms) and search for B. typhosus.*—The work carried out under this heading was of an extensive character, and must needs be considered in separate sections, a, b, c, and d, as follows :—

(a) *Presence or absence of B. coli in* 0·1 *cc. Surface phenol* (0·05 *per cent*) *gelatine plate cultures.*—The results are shown in Table 5.

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* *See* Addendum B., Appendix B, No 3, last year's volume.

† Figs. 13 and 14, Plate XXVI. of this volume.

Table 5

Showing as regards presence or absence of B. coli (or allied forms) in 0·1 cc. the results of the bacteriological examination of thirty samples of Chichester well water, obtained from fourteen different sources.

Sample A[1]	–	*See* Microbe 3, table 8 (no close kinship to B. coli).
Sample B[1]	+	*See* Microbes 1 and 2, table 8 (B. coli or allied forms).
Sample C[1]	–	No subcultures made; no colonies like B. coli.
Sample D[1]	+	But see Microbe 9, table 8.
Sample D[2]	–	No subcultures made; no colonies like B. coli.
Sample E[1]	–	No subcultures made; no colonies like B. coli.
Sample F[1]	–	No subcultures made; no colonies like B. coli.
Sample G[1]	–	No subcultures made; no colonies like B. coli.
„ G[2]	–	„ „ „
„ G[3]	–	„ „ „
Sample H[1]	–	No subcultures made; no colonies like B. coli.
„ H[2]	–	„ „ „
„ H[3]	–	„ „ „
Sample I[1]	+	*See* Microbe 26, table 8 (B. coli or allied form).
„ I[2]	+	*See* Microbes 97, 99, 100, table 8 (B. coli or allied form); also microbes 96 and 98, table (no close kinship to B. coli).
„ I[3]	–	No subcultures made; no colonies like B. coli.
Sample J[1]	–	*See* Microbe 36, table 8 (no close kinship to B. coli).
„ J[2]	–	No subcultures made; no colonies like B. coli).
Sample K[1]	–	*See* Microbe 45, table 8; (no close kinship to B. coli).
„ K[2]	–	*See* Microbe 62, table 8; (no close kinship to B. coli).
„ K[3]	–	No subcultures made; no colonies like B. coli.
Sample L[1]	–	No subcultures made; no colonies like B. coli.
„ L[2]	–	„ „ „ „
„ L[3]	–	*See* Microbe 138, table 8; (no close kinship to B. coli).
Sample M[1]	+	*See* Microbes 80 and 81, table 8; (B. coli or allied forms).
„ M[2]	+	*See* Microbe 113, table 8; (B. coli or allied forms).
„ M[3]	–	No subcultures made; no colonies like B. coli.
Sample N[1]	–	No subcultures made no colonies like B. coli.
„ N[2]	–	„ „ „ „
„ N[3]	–	„ „ „ „

APP. B, No. 6.

On the Chemical and Bacteriological Examination of Chichester Well Water; by Dr. Houston.

It will be noted that six (B^1, D^1, I^1, I^2, M^1, M^2) out of the thirty samples of well water yielded coli-like microbes in 0·1 cc. The remaining twenty-four samples either showed no colonies resembling B. coli in the 0·1 cc. plate cultures, or any colonies simulating B. coli on preliminary observation in the plate cultivations were found on further investigation to bear no close kinship to B. coli.

As regards the samples collected from the same wells but on different dates, it is worthy of note that sometimes B. coli was absent from all the samples, but that in other cases it was present at one time and absent at another. For example, in G^1, G^2, and G^3, collected on November 5th, 1900, January 14th, 1901, and February 12th, 1901, B. coli was absent from 0·1 cc. on all three occasions. On the other hand D^1, collected on October 22nd, 1900, contained a microbe seemingly akin to B. coli, whereas D^2, collected on February 25th, 1900, gave no coli-like colonies in 0·1 cc. Again I^1, I^2, I^3, collected respectively on November 13th, 1900, December 10th, 1900, and February 25th, 1901, differed, in the circumstance that I^1 and I^2 contained B. coli (or allied forms) whereas I^3 did not. Once again, M^1 and M^2, collected on December 3rd, 1900, and January 21st, 1901, contained B. coli in 0·1 cc., but M^3, collected on March 25th, 1901, contained no coli-like microbes in a similar amount of water.

As might be anticipated, the above results suggest some degree of parallelism between B. coli, the total number of bacteria, and the facts as regards gas-production; but it is also evident that too much stress must not be laid on this seeming coincidence.

Without raising the vexed question of standards, it is permissible to say that there seems no justification for "passing" a water containing in 0·1 cc. microbes seemingly closely akin to B. coli when bacteria of comparable sort may be wholly absent from 1, 10, or even 100 cc. of other waters of less suspicious sort.

(b) *Presence or absence of B. coli in* 10 *cc.* surface phenol* (0·05 *per cent.*) *gelatine plate cultures.*—The results are shown in Table 6.

TABLE 6.

Showing as regards presence or absence of B. coli (or allied forms) in 10 cc.* the results of the Bacteriological Examination of thirty samples of Chichester well water obtained from fourteen different sources.

Sample A^1	+	*See* Microbes 4 and 5, table 8 (B. coli or allied forms).
Sample B^1	+	*See* Microbe 7, table 8 (B. coli or allied forms).
Sample C^1	–	No sub-cultures made, no colonies like B. coli.

* 0·1 cc. of a 10 cc. "filter brushing" of 1,000 cc. Pasteur "filter brushing" method.

TABLE 6—*continued*.

Sample D^1	..	+	But *see* Microbes 10 and 11, table 8 (B. coli or allied form).
" D^2	..	–	No sub-cultures made, no colonies like B. coli.
Sample E^1	..	–	No sub-cultures made, no colonies like B. coli.
Sample F^1	..	–	*See* Microbe 20, table 8 (no close kinship to B. coli).
Sample G^1	..	–	No sub-cultures made, no colonies like B. coli.
" G^2	..	–	" " "
" G^3	..	–	" " "
Sample H^1	..	–	No sub-cultures made, no colonies like B. coli.
" H^2	..	–	" " "
" H^3	..	–	" " "
Sample I^1	..	+	*See* Microbes 27 and 29, table 8 (B. coli or allied forms); also microbes 28, 30, 31, 32, 33 (no close kinship to B. coli).
" I^2	..	+	*See* Microbes 101, 102, 103, 104, table 8 (B. coli or allied forms); also microbe 105 (no close kinship to B coli).
" I^3	..	–	No sub-cultures made, no colonies like B. coli).
Sample J^1	..	+	*See* Microbe 37, table 8 (B. coli or allied form); also microbes 38, 39, 40, 41 (no close kinship to B. coli).
" J^2	..	–	*See* Microbes 106, 107, table 8 (no close kinship to B. coli).
Sample K^1	..	–	*See* Microbes 46, 47. 48, 49, 50, 51, table 8 (no close kinship to B. coli).
" K^2	..	–	*See* Microbes 63, 64, 65, 66, 67, 68, table 8 (no close kinship to B coli).
" K^3	..	+	*See* Microbe 136, table 8 (B. coli or allied form).
Sample L^1	..	+	*See* Microbe 55, table 8 (B. coli or allied form); also microbes 56, 57 (no close kinship to B. coli).
" L^2	..	–	*See* Microbes 72, 73, 74, 75 (no kinship to B. coli).
" L^3	..	–	*See* Microbe 139 (no kinship to B. coli).
Sample M^1	..	+	*See* Microbes 82, 84, 89, 90, 92 (B. coli or allied form); also microbes 83, 85, 86, 87, 88, 91 (no kinship to B. coli).
" M^2	..	+	*See* Microbes 114, 115, 116, 117, 118 (B. coli or allied form).
" M^3	..	+	*See* Microbes 141, 143, 145, 146, 147, 148 (B. coli or allied form); also microbes 142, 144 (no kinship to B. coli).
Sample N^1	..	–	No sub-cultures made, no coli like colonies.
" N^2	..	+	*See* Microbe 122, table 8 (B. coli or allied form).
" N^3	..	–	No sub-cultures made, no coli-like colonies.

It will be seen from the above table (Table 6) that twelve (A^1, B^1, D^1, I^1, I^2, J^1, K^3, L^1, M^1, M^2, M^3, N^2) out of the thirty samples yielded coli-like microbes when as much as 10 cc. of the water

was subjected to the phenol gelatine test. The remaining eighteen samples either showed no colonies resembling B. coli in the cultures, or, though showing colonies simulating B. coli on preliminary observation in the plate cultivations failed to yield were found on further study microbes having kinship to B. coli. As before samples collected from the same well but on different dates did not always give similar results. For example, D^1, collected on October 22nd, 1900, contained coli-like microbes in 10 cc. of the water, whereas no micro-organisms of similar sort could be found in D^2, collected on February 25th, 1901. Again, a positive result was obtained in the case of I^1 and I^2, collected respectively on November 13th, 1900, and December 10th, 1900, and a negative result as regards I^3, collected on February 25th, 1901. Once more, L^1 differed from L^2 and L^3, inasmuch as the former (November 19th, 1900) gave a positive and the two latter (November 27th, 1900, and March 11th, 1901 respectively) a negative result in respect of B. coli. Lastly, N^2 (January 21st, 1901) gave a positive result, and N^1 (December 3rd, 1900) and N^3 (March 25th, 1901) contained no coli-like microbes. The different samples from J and K wells also varied as regards presence or absence of B. coli.

On the other hand, M^1 (December 3rd, 1900), M^2 (January 21st, 1901), and M^3 (March 25th, 1900), each contained B. coli or allied forms.

Although the results point as before to a certain parallelism between the total number of bacteria and B. coli, it is equally obvious that to place too much reliance on this apparent relationship might lead to serious errors. For example, K^3 contained B. coli (or closely allied forms) in 10 cc., yet the total number of bacteria in 1 cc, was only 14. Further, N^1 contained no fewer than 812 microbes in 1 cc., yet no coli-like bacteria were found in as much as 10 cc. of the sample.

It is hardly open to contradiction that a water should contain no B. coli in 0·1 cc., but when the quantity involved is 10 cc. the question may, perhaps, be a debatable one. Strictly speaking, no potable water should contain, even in 100 cc. or more, any microbe which can reasonably be considered as being of recent intestinal outcome. But there is great difficulty in coming to any definite conclusion regarding the past history of the coli-like microbe met with in water and soil cultivations, moreover the variability of the coli race of bacteria is so great that it is a matter of perplexity to determine whether a particular micro-organism should or should not be classed as B. coli. B. coli is so peculiarly abundant in sewage as compared with its sparse distribution in waters and soils, that it seems both unwise and unnecessary to push this valuable test too far. I am content to take a moderate view of the question and to regard Samples A^1, B^1, D^1, I^1, I^2, J^1, K^3, L^1, M^1, M^2, M^3, and N^2, as suspicious, and Samples C^1, D^2, E^1, F^1, G^1, G^2, G^3, H^1, H^2, H^3, I^3, J^2, K^1, K^2, L^2, L^3, N^1, and N^3, as showing no evidence of impurity on the basis of the B. coli test, when 10 cc. of the water was submitted thereto.

(c.) *Presence or absence of B. coli in 100 cc.*. Phenol* (0·05 *per cent.*) *broth cultures and subsequent plate cultures.* The results are shown in Table 7.

TABLE 7.

Showing as regards presence or absence of B. coli (or allied forms) in 100 cc *, the results of the bacteriological examination of 30 samples of Chichester well water obtained from 14 different sources.

Sample A^1	? -	*See* Microbe 6, Table 8 (resembled B. coli, but liquified gelatine 11th day).
Sample B^1	+	*See* Microbe 8, Table 8 (B. coli or closely allied forms).
Sample C^1	+	*See* Microbes 15 and 16, Table 8 (B. coli or closely allied forms).
Sample D^1	+	*See* Microbes 12, 13, 14, Table 8 (B. coli or closely allied forms).
„ D^2	+	„ 123, 124, 125, 126, Table 8 (B. coli or closely allied form. *See* also 127, 128, 129 (no close kinship to B. coli).
Sample E^1	+	*See* Microbes 17, 18, 19, Table 8 (B. coli or closely allied forms).
Sample F^1	+	*See* Microbe 21, Table 8 (B. coli or closely allied forms).
Sample G^1	+	*See* Microbes 22, 24, 25, Table 8 (B. coli or closely allied forms.) *See* also 23 (less closely related to B. coli).
„ G^2	+	*See* Microbes 111, 112, Table 8 (B. coli or closely allied forms).
„ G^3	-	No subcultures made; no coli-like colonies.
Sample H^1	-	No diffuse cloudiness in broth cultures, so no plates made from it.
„ H^2	-	No subcultures made: no coli-like colonies.
„ H^3	-	„ „ „ „ „
Sample I^1	+	*See* Microbes 34, 35 (B. coli or closely allied forms.
„ I^2	+	„ 108, 109, 110 (B. coli or closely allied forms).
„ I^3	+	„ 130, 131, 132 „ „ „ *See* also 133, 134, 135 (no close kinship to B. coli).
Sample J^1	+	*See* Microbes 42, 43, 44 (B. coli or closely allied forms).
„ J^2	-	No subcultures made; no coli-like colonies.
Sample K^1	-	*See* Microbes 52, 53, 54 (no close kinship to B. coli).
„ K^2	+	„ 69, 70, 71 (B. coli or closely allied forms).
„ K^3	+	*See* Microbe 137 (B. coli or closely allied forms).
Sample L^1	? -	*See* Microbe 58 (no gas; otherwise resembled B. coli). *See* also Microbes 59, 60, 61 (no close kinship to B. coli).§
„ L^2	+	*See* Microbes 76, 77, 78, 79 (B. coli or closely allied forms).
„ L^3	? -	*See* Microbe 140 (no very definite kinship to B. coli).

* 0·1 cc. of a 10 cc. "filter brushing" of 1,000 cc. Pasteur "filter brushing" method.
§ In the case of Samples A^1, L^1, and N^2 a positive result was obtained with 0·1 of a 10 cc. "filter brushing" of 1,000 cc. (surface phenol 0·05 per cent.) gelatine plate culture.

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was subjected to the phenol gelatine test. The remaining eighteen samples either showed no colonies resembling B. coli in the cultures, or, though showing colonies simulating B. coli on preliminary observation in the plate cultivations failed to yield were found on further study microbes having kinship to B. coli. As before samples collected from the same well but on different dates did not always give similar results. For example, D^1, collected on October 22nd, 1900, contained coli-like microbes in 10 cc. of the water, whereas no micro-organisms of similar sort could be found in D^2, collected on February 25th, 1901. Again, a positive result was obtained in the case of I^1 and I^2, collected respectively on November 13th, 1900, and December 10th, 1900, and a negative result as regards I^3, collected on February 25th, 1901. Once more, L^1 differed from L^2 and L^3, inasmuch as the former (November 19th, 1900) gave a positive and the two latter (November 27th, 1900, and March 11th, 1901 respectively) a negative result in respect of B. coli. Lastly, N^2 (January 21st, 1901) gave a positive result, and N^1 (December 3rd, 1900) and N^3 (March 25th, 1901) contained no coli-like microbes. The different samples from J and K wells also varied as regards presence or absence of B. coli.

On the other hand, M^1 (December 3rd, 1900), M^2 (January 21st, 1901), and M^3 (March 25th, 1900), each contained B. coli or allied forms.

Although the results point as before to a certain parallelism between the total number of bacteria and B. coli, it is equally obvious that to place too much reliance on this apparent relationship might lead to serious errors. For example, K^3 contained B. coli (or closely allied forms) in 10 cc., yet the total number of bacteria in 1 cc, was only 14. Further, N^1 contained no fewer than 812 microbes in 1 cc., yet no coli-like bacteria were found in as much as 10 cc. of the sample.

It is hardly open to contradiction that a water should contain no B. coli in 0·1 cc., but when the quantity involved is 10 cc. the question may, perhaps, be a debatable one. Strictly speaking, no potable water should contain, even in 100 cc. or more, any microbe which can reasonably be considered as being of recent intestinal outcome. But there is great difficulty in coming to any definite conclusion regarding the past history of the coli-like microbe met with in water and soil cultivations, moreover the variability of the coli race of bacteria is so great that it is a matter of perplexity to determine whether a particular micro-organism should or should not be classed as B. coli. B. coli is so peculiarly abundant in sewage as compared with its sparse distribution in waters and soils, that it seems both unwise and unnecessary to push this valuable test too far. I am content to take a moderate view of the question and to regard Samples A^1, B^1, D^1, I^1, I^2, J^1, K^3, L^1, M^1, M^2, M^3, and N^2, as suspicious, and Samples C^1, D^2, E^1, F^1, G^1, G^2, G^3, H^1, H^2, H^3, I^3, J^2, K^1, K^2, L^2, L^3, N^1, and N^3, as showing no evidence of impurity on the basis of the B. coli test, when 10 cc. of the water was submitted thereto.

(c.) *Presence or absence of B. coli in 100 cc.*. Phenol* (0·05 *per cent.*) *broth cultures and subsequent plate cultures.* The results are shown in Table 7.

TABLE 7.

Showing as regards presence or absence of B. coli (or allied forms) in 100 cc *, the results of the bacteriological examination of 30 samples of Chichester well water obtained from 14 different sources.

Sample A¹	?-	*See* Microbe 6, Table 8 (resembled B. coli, but liquified gelatine 11th day).
Sample B¹	+	*See* Microbe 8, Table 8 (B. coli or closely allied forms).
Sample C¹	+	*See* Microbes 15 and 16, Table 8 (B. coli or closely allied forms).
Sample D¹	+	*See* Microbes 12, 13, 14, Table 8 (B. coli or closely allied forms).
" D²	+	" 123, 124, 125, 126, Table 8 (B. coli or closely allied form. *See* also 127, 128, 129 (no close kinship to B. coli).
Sample E¹	+	*See* Microbes 17, 18, 19, Table 8 (B. coli or closely allied forms).
Sample F¹	+	*See* Microbe 21, Table 8 (B. coli or closely allied forms).
Sample G¹	+	*See* Microbes 22, 24, 25, Table 8 (B. coli or closely allied forms.) *See* also 23 (less closely related to B. coli).
" G²	+	*See* Microbes 111, 112, Table 8 (B. coli or closely allied forms).
" G³	-	No subcultures made ; no coli-like colonies.
Sample H¹	-	No diffuse cloudiness in broth cultures, so no plates made from it.
" H²	-	No subcultures made : no coli-like colonies.
" H³	-	" " " " "
Sample I¹	+	*See* Microbes 34, 35 (B. coli or closely allied forms.
" I²	+	" 108, 109, 110 (B. coli or closely allied forms).
" I³	+	" 130, 131, 132 " " ". *See* also 133, 134, 135 (no close kinship to B. coli).
Sample J¹	+	*See* Microbes 42, 43, 44 (B. coli or closely allied forms).
" J²	-	No subcultures made ; no coli-like colonies.
Sample K¹	-	*See* Microbes 52, 53, 54 (no close kinship to B. coli).
" K²	+	" 69, 70, 71 (B. coli or closely allied forms).
" K³	+	*See* Microbe 137 (B. coli or closely allied forms).
Sample L¹	?-	*See* Microbe 58 (no gas ; otherwise resembled B. coli). *See* also Microbes 59, 60, 61 (no close kinship to B. coli).§
" L²	+	*See* Microbes 76, 77, 78, 79 (B. coli or closely allied forms).
" L³	?-	*See* Microbe 140 (no very definite kinship to B. coli).

* 0·1 cc. of a 10 cc. "filter brushing" of 1,000 cc. Pasteur "filter brushing" method.
§ In the case of Samples A¹, L¹, and N² a positive result was obtained with 0·1 of a 10 cc. "filter-brushing" of 1,000 cc. (surface phenol 0·05 per cent.) gelatine plate culture.

TABLE 7—*continued*.

Sample M^1	+	*See* Microbes 93, 94, 95 (B. coli or allied forms).
" M^2	+	*See* Microbes 119, 120, 121 (B. coli or allied forms).
" M^3	+	*See* Microbe 140 (B. coli or allied forms).
Sample N^1	–	No subcultures made ; no coli-like microbes.
" N^2	–	" " " " §
" N^3	+	*See* Microbe 150 (B. coli or allied form).

§ In the case of Samples A^1, L^1, and N^2 a positive result was obtained with 0·1 of a 10 cc. "filter brushing" of 1,000 cc. (surface phenol 0·05 per cent.) gelatine plate culture.

As regards Samples A^1, L^1, and N^2, the result was negative in N^2, and in A^1 and L^1 it was doubtfully negative. Nevertheless, in all these three samples coli-like microbes obtained in the phenol gelatine plate cultures when using less of the water.

All the remaining samples yielded coli-like microbes, except G^3, H^1, H^2, H^3, J^2, K^1, L^3 (?), and N^1. Including A^1, L^1, and N^2 (since a positive result was obtained with a less quantity), it may be said that no less than 22 (23 if L^3 is included) out of the 30 samples of well water yielded a positive result as regards the presence of coli-like microbes. As before samples collected from the same well, but on different dates, did not when 100 cc. were used always give similar results. For example, compare G^1 and G^2 with G^3, and J^1 with J^2.

It is evident on these further data that there is no *necessary* relation between total numbers of microbes and presence or absence of B. coli. For example, E^1 and F^1 contained respectively only 14 and 12 microbes per cc. Nevertheless, the presence of coli-like microbes was demonstrated in both these samples. On the other hand, B. coli was not found in N^1, although it contained no fewer than 812 microbes in 1 cc. At the same time, as might be expected, there was usually some agreement between the presence or absence of B. coli and the greater or lesser abundance of bacteria of all sorts.

How far one is justified in condemning a water containing coli-like microbes in 100 cc., when these micro-organisms are absent from 10 cc., is a moot point. It may, at all events, be safely said that Samples G^3, H^1, H^2, H^3, J^2, K^1, N^1, and L^3 (?) were conspicuous as regards their purity, and that those samples (C^1, D^2, E^1, F^1, G^1, G^2, I^3, K^2, L^2, L^3 (?), N^3) which contained B. coli (or allied forms) in 100 cc. but not in 10 cc., were not wholly free from microbes seemingly of intestinal origin, and so could not be regarded as entirely unobjectionable in character.

Some bacteriologists consider that no microbe should be classed as B. coli unless it responds to *all* of a number of positive tests in a specified and quite arbitrary period. Others go still further and assert that no microbe failing to give rapid affirmative response to all of these tests is to be regarded as even an ally of B. coli, or as

in any way indicative of fouling (of any water) with objectionable animal matters. Remembering that sewage teems with coli-like microbes presenting every possible variation from the classical B. coli (some of them perhaps of greater importance than the ideal B. coli), and that some of the positive attributes originally possessed by these microbes may be easily lost or be maintained only in diminished degree under certain conditions, it seems unwise to place too much faith in these doctrines. Nevertheless, it is quite true that it is easy to drift into the opposite error, and consider microbes as B. coli which have no real kinship to that micro-organism and which bear no relation to pollution of animal outcome. In this investigation an endeavour has been made to steer a middle course, but as all the facts connected with the work are set forth in detail, it is open to anyone to draw their own conclusions and interpret the results after their own fashion.

(d) *Differentiation from b. typhosus of the coli-like microbes isolated from the various samples of well water.*—In the following table (Table 8) an account is given of the results of sub-culture of the various coli-like microbes met with during the course of the investigation.

TABLE 8.

Number of Microbe.	Source.				Motility.	Morphology (coli-like on the whole).	"Gas" in gelatine shake cultures, 24 hours at 20° C.	Diffuse cloudiness in broth cultures, 24 hours at 37° C.	Indol in broth cultures, 5 days at 37° C.	Litmus milk cultures, 5 days at 37° C.		Liquefaction of gelatine, 30 days.	Widal's reaction, 1:20 (1 hour).	
	Well Water.	Amount of water in cc.								Acidity.	Clot.		Human typhoid blood.	Blood of guinea-pig immunised with cultures of living B. typhosus.
		0·1	10	100										
1	B¹	+			+	+	+	+	+ trace.	+ weak.	-	-	-	
2	B¹	+			+	+	+	+	-	+	-	-	-	
3	A¹	+					-	[This microbe, on further study, was found to bear no resemblance to B. coli or B. typhosus].						
4	A¹		+		+	+	+	+	-	+	-	-	-	
5	A¹		+		+	+	+	+	-	+	-	-	-	
6	A¹			+			+	+	-	+	-	+ 11th day.		
7	B¹		+		+	+	+	+	+	+	+	-	-	
8	B¹			+	+	+	+	+	+	+	+	-	-	
9	D¹	+			+	+	+	+	-	+ slight.	-	-	-	
10	D¹		+		+	+	+	+	-	+ slight.	-	-	-	
11	D¹		+		+	+	+	+	-	+ slight.	-	-	-	
12	D¹			+	+	+	+	+	+	+	+	-	-	

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TABLE 8—*continued.*

Number of Microbe.	Source. Well Water.	Amount of water in cc. 0·1	10	100	Motility.	Morphology (coli-like on the whole).	"Gas" in gelatine shake cultures, 24 hours at 20° C.	Diffuse cloudiness in broth cultures, 24 hours at 37° C.	Indol in broth cultures, 5 days at 37° C.	Litmus milk cultures, 5 days at 37° C. Acidity.	Clot.	Liquefaction of gelatine, 30 days.	Widal's reaction, 1:20 (1 hour). Human typhoid blood.	Blood of guinea-pig immunised with cultures of living B. typhosus.
13	D^1			+	+	+	+	+	+	+	+	-	-	
14	D^1			+	+	+	+	+	+	+	+	-		-
15	C^1			+	+	+	+	+	+	+	+	-		-
16	C^1			+	+	+	+	+	+	+	+	-		-
17	E^1			+	+	+	+	+	-	+	-	-		-
18	E^1			+	+	+	+	+	-	+	-	-		-
19	E^1			+	+	?+	+	+	-	+	-	-		-
20	F^1		+				-	[No growth in broth or milk at 37° C., so further study abandoned.]						
21	F^1			+	+	+	+	+	-	+	-	-		-
22	G^1			+	?+	?+	+	+	-	+	+	-		-
23	G^1			+	+	?+	+	+	-	-	-	-		-
24	G^1			+	+	?+	+	+	-	+	+	-		-
25	G^1			+	+	+	+	+	-	+	+	-		-
26	I^1	+			?	?+	+	+	-	+	-	-		-
27	I^1		+		?	+	+	+	-	+	-	-		-
28	I^1		+		+	?+	-		-	+	-	-		-
							[On further study, this microbe was found to grow better at 20° C. than at 37° C. It formed a luxuriant cream coloured growth on potato. The growth in broth (at 20° C.) resembled neither B. coli nor B. typhosus.]							
29	I^1		+		+	+	+	+	-	+	-	-		-
30	I^1		+				-	[No growth in broth or milk at 37° C.; by 4th day liquefaction of gelatine and formation of yellow pigment.]						
31	I^1		+				-	[No growth in broth or milk at 37° C.; by 5th day yellowish colour and commencing liquefaction of gelatine.]						
32	I^1		+				-	[Same remarks as 31.]						
33	I^1		+				-	[In broth cultures, diffuse cloudiness at first but later flocculent cloudiness and surface pellicle. In litmus milk cultures acidity, later dull faded appearance, later still peptonisation.]						
34	I^1			+	+	+	+	+	-	+	-	-		-
35	I^1			+	+	+	+	+	+	+	+	-		-
36	J^1	+			+	+	-	+ slight.	-	+ weak.	-	+ 8th day.		
							[On further study, the microbe was found to bear little or no resemblance to B. coli or B. typhosus.]							

TABLE 8—*continued.*

Number of Microbe.	Source. Well Water.	Amount of water in cc. 0·1	10	100	Motility.	Morphology (coli-like on the whole).	"Gas" in gelatine shake cultures, 24 hours at 20° C.	Diffuse cloudiness in broth cultures, 24 hours at 37° C.	Indol in broth cultures, 5 days at 37° C.	Litmus milk cultures, 5 days at 37° C. Acidity.	Clot.	Liquefaction of gelatine, 30 days.	Widal's reaction, 1:20 (1 hour). Human typhoid blood.	Blood of guinea-pig immunised with cultures of living B. typhosus.
37	J¹		+		?	+	+	+	-	+	-	-		-
38	J¹		+				-	+ slight.	-	-	-	+ 5th day.		
							[As the microbe liquefied gelatine, its further study was abandoned.]							
39	J¹		+				-	+	-					
							[As this microbe produced distinct peptonisation in litmus milk culture, its further study was abandoned.]							
40	J¹		+				[This microbe appeared to be identical with microbe 39.]							
41	J¹		+				[This microbe appeared to be identical with microbes 39 and 40.]							
42	J¹			+	+	+	+	+	+ slight.	+	+	-	+ some. - others.	+ ¶
43	J¹			+	+	+	+	+	+ slight.	+	+	-	+ some. - others.	+ ¶
44	J¹			+	+		+	+	+ slight.	+	+	-	+ some. - others.	+ ¶
							[Morphologically: longer rods than B. coli but shorter than B. typhosus; more flagella than B. coli but less than B. typhosus.]							
45	K¹	+			?	+	-	+ slight.	-	+ slight.	-	-		-
							[On further study this microbe was found to grow much better at 20° C. than at 37° C.]							
46	K¹		+		+	+	-	+ feeble.	-	+ feeble.	-	-		-
							[On further study this microbe was found to grow much better at 20°C. than at 37° C.]							
47	K¹		+				-	[On further study this microbe was found to be a slow liquefier, so its further study was abandoned.]						
48	K¹		+				-	[Eventually produced yellow orange colouration in gelatine culture.]						
49	K¹		+		+		-	- slight.	-	+ slight.	-	-		-
							[On further study this microbe was found to grow better at 20° than at 37° C. In broth at 20° C., a distinct surface pellicle was formed after a few days incubation. The rods were longer than B. coli but shorter than B. typhosus.]							
50	K¹		+				-	[In gelatine "shake" culture no growth occurred except near the surface, even after four days at 20° C.]						
51	K¹		+				-	[In gelatine "shake" culture no growth occurred except near the surface and liquefaction began on the fourth day.]						

TABLE 8—*continued.*

Number of Microbe.	Source.				Motility.	Morphology (coli-like on the whole).	"Gas" in gelatine shake cultures, 24 hours at 20° C.	Diffuse cloudiness in broth cultures, 24 hours at 37° C.	Indol in broth cultures, 5 days at 37° C.	Litmus milk cultures, 5 days at 37° C.		Liquefaction of gelatine, 30 days.	Widal's reaction, 1:20 (1 hour).	
	Well Water.	Amount of water in cc.								Acidity.	Clot.		Human typhoid blood.	Blood of guinea-pig immunised with cultures of living B. typhosus.
		0·1	10	100										
52	K^1			+	?	+	–	+	+ slight.	+ slight, and milk acquired a bleached look.	–	–	–	
53	K^1			+	+	+	–	+	+ slight.	+ same remarks as 52.	–	–	–	
54	K^1			+	+	+	–	+	+ slight.	+ same remarks as 52.	–	–		–
55	L^1		+		+	+	+	+	+	+	–	–		–
56	L^1		+		+	+	+	+	–	–	–	–		–
57	L^1		+				–	[In gelatine "shake" culture no growth occurred except near the surface, even after four days at 20° C.]						
58	L^1			+	?	+	–	+	+	+	+	–	–	
59	L^1			+			–	[In gelatine "shake" culture no growth occurred except near the surface, and in four days green fluorescence.]						
60	L^1			+			–	[Same remarks as 59.]						
61	L^1			+			–	[Same remarks as 59.]						
62	K^2	+					+	[Later, liquefaction of gelatine.]						
63	K^2		+				–	[No growth in broth or milk at 37° C.]						
64	K^2		+				–	+	–	+	–	+ 10th day.		
65	K^2		+				–	+ Feeble growth.	–	–	–	+ 18th day.		
66	K^2		+				+	+	–	+ Slight.	? +	+ 5th day.		
67	K^2		+				–	+ Feeble growth.	[No visible change in milk culture and eventually green fluorescence in gelatine culture.]					
68	K^2		+				–	[No growth in broth or milk cultures at 37° C.]						
69	K^2			+	+	+	+	+	+ Slight.	+	+	–	–	
70	K^2			+	+	+		+	–	+	–	–		–
71	K^2			+	+	+	+	+	–	+	–	–	–	
72	L^2		+				–	[Eventually, green fluorescence in gelatine culture.]						

TABLE 8—*continued.*

Number of Microbe.	Source. Well Water.	Amount of water in cc. 0·1	10	100	Motility.	Morphology (coli-like on the whole).	"Gas" in gelatine shake cultures, 24 hours at 20° C.	Diffuse cloudiness in broth cultures, 24 hours at 37° C.	Indol in broth cultures, 5 days at 37° C.	Litmus milk cultures, 5 days at 37° C. Acidity.	Clot.	Liquefaction of gelatine, 30 days.	Widal's reaction, 1:20 (1 hour). Human typhoid blood.	Blood of guinea-pig immunised with cultures of living B. typhosus.
73	L^2		+				-	[Same remarks as 72.]						
74	L^2		+				-	[Same remarks as 72.]						
75	L^2		+				-	[Same remarks as 72.]						
76	L^2			+	+	+	+	+	-	+	-	-	-	
77	L^2			+	?	+	+	+	+	+	+	-	-	
78	L^2			+	+	+	+	+	+	-	-	-		-
79	L^2			+	?	+	+	+	+	+	+	-		-
80	M^1	+			+	+	+	+	-	+	+	-		-
81	M^1	+			+	+	+	+	-	+	+	-		-
82	M^1		+		+	+	+	+	-	+	+	-		-
83	M^1		+				-	[Later, liquefaction of gelatine.]						
84	M^1		+		+	+	+	+	-	+	-	-		-
85	M^1		+				[No gas, and later liquefaction of gelatine.]							
86	M^1		+				"			"	"			
87	M^1		+				"			"	"			
88	M^1		+				"			"	"			
89	M^1		+		+	+	+	+	-	+	-	-		-
90	M^1		+		+	+	+	+	-	+	-	-		-
91	M^1		+				[No gas, and later liquefaction of gelatine.]							
92	M^1		+		+	+	+	+	-	+	+	-		-
93	M^1			+	+	+	+	+	-	+	-	-		-
94	M^1			+	+	+	+	+	-	+	-	-		-
95	M^1			+	+	+	+	+	-	+	-	-		-
96	I^3	+					+ slight	+	-	+	-	+ 6th day.		
97	I^3	+			+	+	+	+	-	+	-	-		-
98	I^3	+					[No gas, and later green fluorescence.]							
99	I^3	+			+	+	+	+	-	+	+	-		-
100	I^3	+			+	+	+	+	-	+	-	-		-
101	I^3		+		+	+	+	+	-	+	-	-		-
102	I^3		+		+	+	+	+	-	+	-	-		-
103	I^3		+		+	+	+	+	-	+	-	-		-
104	I^3		+		+	+	+	+	-	+	-	-		-

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TABLE 8—*continued.*

Number of Microbe.	Source. Well Water.	Amount of water in cc. 0·1	10	100	Motility.	Morphology (coli-like on the whole).	"Gas" in gelatine shake cultures, 24 hours at 20° C.	Diffuse cloudiness in broth cultures, 24 hours at 37° C.	Indol in broth cultures, 5 days at 37° C.	Litmus milk cultures, 5 days at 37° C. Acidity.	Clot.	Liquefaction of gelatine, 30 days.	Widal's reaction, 1:20 (1 hour). Human typhoid blood.	Blood of guinea-pig immunised with cultures of living B. typhosus.
105	I^2		+				[No gas, and later liquefaction of gelatine.]							
106	J^2		+				[No gas, in gelatine "shake" culture, and growth occurred at the surface, not at depth.]							
107	J^2		+				[Same remarks as 106.]							
108	I^2			+	+	+	+	+	-	+	+	-		-
109	I^2			+	+	+	+	+	-	+	+	-		-
110	I^2			+	+	+	+	+	-	+	+	-		-
111	G^2			+	+	?+	+	+	+	+	+	-		? -
112	G^2			+	?	?+	+	+	+	+	+	-		-
113	M^2	+			+	+	+	+	-	+	-	-		-
114	M^2		+		+	+	+	+	-	+	-	-		(+)*
115	M^2		+		+	+	+	+	-	+	-	-		(-)*
116	M^2		+		?	+	+	+	-	+	+	-		(-)*
117	M^2		+		?	+	+	+	-	+	-	-	-	
118	M^2		+		+	+	+	+	-	+	-	-	-	
119	M^2			+	+	+	+	+	-	+	-	-	-	
120	M^2			+	+	+	+	+	-	+	-	-	-	
121	M^2			+	?	+	+	+	-	+	+	-	-	
122	N^2		+		+	+	+	+	-	+	+	-	-	
123	D^2			+	+	+	+	+	-	+	+	-	-	
124	D^2			+	+	+	+	+	-	+	+	-	-	
125	D^2			+	+	+	+	+	-	+	-	-		? -§
126	D^2			+	+	+	+	+	-	+	-	-		? -§
127	D^2			+			[No gas and later liquefaction of gelatine.]							
128	D^2			+			" " "							
129	D^2			+			" " "							
130	I^2			+	+	+	+	+	-	+	-	-		? -
131	I^2			+	+	+	+	+	-	+	-	-	-	
132	I^2			+	+	+	+	+	-	+	-	-	-	
133	I^2			+			[No gas and later liquefaction of gelatine.]							
134	I^2			+			" " "							
135	I^2			+			" " "							

TABLE 8—*continued.*

Number of Microbe.	Source.				Motility.	Morphology (coli-like on the whole).	"Gas" in gelatine shake cultures, 24 hours at 20° C.	Diffuse conditions in broth cultures, 24 hours at 37° C.	Indol in broth cultures, 5 days at 37° C.	Litmus milk cultures, 5 days at 37° C.		Liquefaction of gelatine, 30 days.	Widal's reaction, 1 : 20 (1 hour).	
	Well Water.	Amount of water in cc.								Acidity.	Clot.		Human typhoid blood.	Blood of guinea-pig immunised with cultures of living B. typhosus.
		0·1	10	100										
36	K^3		+		?	+	+	+	+	+	+	-	-	
37	K^3			+	?	+	+	+	+	+	+	-	-	
38	L^3	+			+	?	-	+	-	? trace	-	-		-
							[Abundant fawn coloured growth on potato. Rods somewhat longer than B. coli but unlike B. typhosus.]							
39	L^3		+		+	? +	-	+	-	? trace	-	-		-
							[Abundant fawn coloured growth on potato. Rods not quite like B. coli but unlike B. typhosus.]							
40	L^3			+	+	+	+	+	-	-	-	-	-	
41	M^3		+		+	+	+	+	-	+ slight	-	-	-	
42	M^3		+				[No gas and later liquefaction of gelatine.]							
43	M^3		+		?	+	+	+	-	+	-	-	-	
44	M^3		+				[No gas and later liquefaction of gelatine.]							
45	M^3		+		+	+	+	+	-	+	-	-	-	
46	M^3		+		+	+	+	+	-	+	-	-	-	
47	M^3		+		+	+	+	+	-	+	-	-	-	
48	M^3		+		+	+	+	+	-	+ slight	-	-	+‡	
49	M^3			+	+	+	+	+	+	+	-	-	-	
50	N^3			+	+	+	+	+	-	+	-	-	-	

* Here the blood of a rabbit highly immunised with dead typhoid bacilli kindly given me by Dr. Schölberg was used. 114 gave a distinctly positive result and 115 and 116 a wholly negative result 114, however, did not give a definitely positive result with the blood of a guinea-pig immunised to a moderate extent with living cultures of B. typhosus.

§ Here the blood of a guinea-pig immunised with living typhoid cultures kindly given me by Dr. Klein was used. The result was on the whole negative but with a query.

‡ Not strongly marked but enough to warrant a positive diagnosis.

† Negative with a query.

¶ Well marked positive result with the blood of a typhoid immunised guinea-pig. Positive result with the blood of some cases of human typhoid; negative in other cases.

The above table includes the study of the many microbes (150) isolated from the different waters which could not on preliminary observation in the original plate cultures be definitely said not to be B. typhosus. In most cases these, as might be expected, turned out to be B. coli (or allied forms). In some cases microbes showed little or no resemblance to B. coli on further study. In no instance was any serious difficulty encountered in differentiating any from B. typhosus.

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In summary of these results the following points as regards the 150 micro-organisms in question seem worthy of note :—

Non-liquefying gas-forming coli-like microbes. — Ninety examples were dealt with, and with result as follows :—

90 microbes.	"Gas" in gelatine "shake" cultures.	Diffuse cloudiness in broth cultures.	Acidity in litmus milk cultures.	Acid clot, litmus milk cultures.	Indol in broth cultures.
18 = (20 °/o).	+	+	+	+	+
16 = (17·78 °/o).	+	+	+	+	−
49 = (54·45 °/o).	+	+	+	−	−
3 = (3·34 °/o).	+	+	−	−	−
1 = (1·12 °/o).	+	+	+ weak.	−	+
2 = (2·23 °/o).	+	+	+	−	+
1 = (1·12 °/o).	+	+	−	−	+

Gas-producing coli-like microbes, which eventually liquefied gelatine.—Of these there were four examples, and some of them, apart from the fact of their liquefying gelatine, were not unlike B. coli.

Non-gas-producing coli-like (on preliminary observation) microbes which eventually liquefied gelatine.—Of these there were 24 examples. None of them, of course, could be regarded as showing any close kinship to B. coli. They naturally bore no relation at all to B. typhosus.

Non-gas-producing coli-like (on preliminary observation) microbes which were not observed to be liquefiers. 32 examples. Ten eventually proved themselves to be chromogenic microbes. Three failed to show any growth in broth or milk cultures incubated at 37° C. One (58) was of interest because, although giving no "gas" in "shake" cultures, it produced diffuse cloudiness in broth, gave the indol reaction, and also produced acid-clotting of milk. Four grew much better at 20° C. than at 37° C., and in other respects disassociated themselves from B. coli and from the typhoid bacillus. Four gave no "gas" in "shake" cultures and the growth was confined to the surface, none showing "at depth." (B. coli and B. typhosus both show, of course, a decided growth "at depth.") Four produced distinct peptonisation in litmus-milk cultures. These were somewhat peculiar; they gave no gas and yielded no clot in milk, gave feeble cloudiness in broth and yet faint indol reaction, gave slight acidity in milk, but later the milk acquired a bleached look. One is entered in my notes as giving no gas, but showing on further study no

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resemblance to B. coli or B. typhosus. The remaining two (138, 139) are not devoid of interest: they gave no gas, no indol, no clot, and did not liquefy gelatine. They yielded a trace (?) of acidity in milk culture. The result as regards Widal's reaction was negative. On potato the growth was luxuriant and fawn coloured. They were motile, and although the rods were somewhat longer than B. coli they did not seem to be quite like B. typhosus. In brief, these microbes could not be considered as showing any close kinship to B. coli; and although of some little interest in view of a certain superficial resemblance to B. typhosus, they could not be regarded as related thereto.

Widal's reaction.—All those microbes which bore any reasonable resemblance either to B. coli or B. typhosus were tested as regards Widal's reaction. This proved to be a somewhat arduous task, as the number tested was 97. Sometimes human typhoid blood serum* was used, and sometimes the blood of a guinea-pig immunised with living typhoid bacillus cultures. The time limit was 1 hour, and the dilution 1 : 20. Some may consider that a dilution 1 : 50; or 1 : 100 or even 1 : 500 should have been used. But as nearly all my results were negative when using a dilution of 1 : 20 this objection seemingly falls to the ground. By using too great a dilution the risk is run of failing to draw any distinction between the few coli microbes which unquestionably respond to the agglutination test and the large number which yield an absolutely negative result. Yet this distinction may be of great importance. Nevertheless I am in close agreement with those who assert that to prove the true nature of a suspected typhoid microbe high dilutions of the serum of typhoid immunised animals should be used. Unfortunately none of my microbes bore so close a resemblance to B. typhosus as to render this precaution necessary. Recent (24–48, but nearly always 24 hours) gelatine cultures (oblique) were used, and the emulsion was made in broth. Although the great majority of coli-like microbes formed a homogeneous emulsion, this was not always found to be the case. Indeed, with some it was quite impossible to obtain an emulsion free from clumps of bacilli. In these cases it was only possible to arrive at a diagnosis by close comparison with a control experiment. As a matter of fact the diagnosis was negative in all of these instances, although if no control had been made it would have most certainly been regarded as positive. At first sight it might appear probable that earlier observers may have fallen into error in this direction. But there is no reason to suppose that they neglected the precaution of making control experiments. It was commonly observed during the progress of each separate experiment that the microbes at first actively motile, gradually showed less and less motility as time wore on, and that not infrequently they showed as well what I am at a loss to describe otherwise than a

* I was not able to imitate Dr. Lorrain Smith's admirable work. He tested his coli-like microbes, isolated from an implicated water supply, with the very blood of the patients believed to have contracted enteric fever through drinking the water. The typhoid blood in my experiment bore no relation to Chichester. A brief summary of Dr. Lorrain Smith's report is given in Addendum A.

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"tendency to clump" or a "suspicion of clumping," if such loose terms are permissible.* This appearance was always recorded as negative because a really positive result when it occurs is so striking and unmistakeable, that to drag in extremely doubtful cases is apt to lead to much confusion. As regards the multiple negative results, it must be understood that it is not contended that the microbes concerned would *necessarily* have yielded negative results with *all* samples of blood under parallel conditions of experiment. Conversely, a positive result does not necessarily mean that the microbe of experiment would have yielded similar results with *all* specimens of typhoid blood. It is well known that typhoid blood varies greatly both in the degree of its clumping ability and in its behaviour towards different strains of the typhoid bacillus and to one or another race of B. coli. From Dr. Schölberg's† results (when working with injections of dead typhoid bacilli) I gather that immunisation in animals may be gradually pushed so as, side by side with the progressive increase of clumping power of the blood, to induce an increasing number of coli-like microbes to give positive response to Widal's test. Some of my multiple negative results might have been positive if the blood used had been much "stronger" in its clumping ability, or possessed of some peculiar quality in "negative‡ sympathy" with the particular microbes of experiment. Some of my rare positive results might have been negative if the blood used had been "weaker" in clumping power or free from "negative sympathy" with the micro-organisms of experiment. Be it noted, however, that as regards the positive results the same blood had no appreciable clumping effect under the same conditions of experiment when tried on other strains of B. coli; so it could not be the case that the positive result was simply due to the use of a blood possessed of a peculiarly potent clumping power. *Either these coli-like microbes yielding a positive result were intrinsically different from the strains of B. coli giving a negative result, or they were possessed of some peculiar quality in advance of their fellows.*

Of the 97 microbes of experiment no fewer than 88§ gave either a wholly negative result or one which was so doubtful as to lead me to record the result as negative.

Four microbes (111, 125, 126, 130) were so doubtfully positive (typhoid immunised guinea-pig) that they were labeled as negative with a query.

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* Dr. Schölberg informs me that with the blood of animals examined daily after typhoid inoculations but before the onset of the agglutination on the fifth day, it is quite usual to find a loss of motility only and no clumping on the third and fourth days. And in the fluctuations of the maximum agglutinating points a loss of motility, with very slight clumping, is all the reaction a high dilution gives to a serum which clumps well at a lower dilution.

† I am much indebted to Dr. Andrewes and Dr. Schölberg for obtaining for me specimens of human typhoid blood. And Dr. Schölberg was very kind in frequently giving me the benefit of his large experience in this class of work.

‡ I use the word negative because clumping is an antagonistic quality.

§ In 38 cases human typhoid blood was used, and in 50 cases the blood of a typhoid immunised animal.

One microbe (148) yielded a positive result (human typhoid blood); not strongly marked it is true, but enough to warrant a positive diagnosis.

One microbe (114) yielded a distinctly positive result with the blood of a rabbit (highly immunised with dead typhoid bacilli), but a doubtfully positive result with the blood of a guinea-pig (immunised to a moderate extent with living typhoid bacilli).

The remaining three microbes (42, 43, 44) gave a strongly-marked positive result with the blood of a typhoid immunised guinea-pig. They also reacted distinctly with the blood of some human typhoid cases, less decidedly with that of others, and practically not at all in some instances.*

These three microbes were all obtained from the same sample of water; and they were all completely typical of B. coli as regards gas production, uniform turbidity in broth cultures in 24 hours at 37, acid clotting of milk, and indol formation. It is worthy of note, however, that 44, which was specially conspicuous as regards clumping, differed from B. coli morphologically, inasmuch as the rods were longer and thinner and more actively motile than in the case of that micro-organism.

A guinea-pig was immunised with microbe 44, and the blood of this animal was repeatedly tested against the same strain of B. typhosus which had been used to immunise the typhoid immunised guinea-pig whose blood was so active in clumping microbe 44. Some little difficulty was experienced in carrying out this work, as microbe 44 was decidedly pathogenic. The results were wholly negative, and I am unable to frame any hypothesis to explain these results. It is easy to see why the blood of a typhoid fever patient should be capable of clumping some races of B. coli. Because, as has been pointed out by several observers, typhoid fever may be a mixed infection.† But why the blood of a typhoid immunised animal should clump an

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* At the time of writing this report Dr. Schölberg was working with a serum of high agglutinating power (rabbit immunised by intra-venous injection with dead typhoid cultures). He was kind enough to test microbes 42, 43, 44, 114, and 148 for me with the blood of this rabbit. Microbes 42, 43, and 44 gave somewhat similar results, but the reaction was most marked in the case of 44, namely, 1 : 10 dilution, positive result almost instantaneous; 1 : 20 *dilution, positive result within* 30 *minutes and complete clumping within* 60 *minutes*; 1 : 30 dilution, positive result, but not complete in 60 minutes. *Microbe* 114, 1 : 1000 *suspicion of clumping.* 1 : 400 *distinct clumping, and* 1 : 300 *distinct clumping and complete reaction in one hour.* Microbe 148 gave a practically negative result 1 : 30 dilution. Dilutions 1 : 10 and 1 : 20 yielded a barely positive and incomplete result within 60 minutes. *This same blood tested against one of Dr. Klein's strains of B. coli kept in stock as fulfilling all the characters of the classical B. coli yielded a negative result* 1 : 10 *dilution*, 24 *hours.*

† Nevertheless Dr. Schölberg has pointed out to me that an artificially induced mixed infection need not necessarily produce the "infection reaction" with all the micro-organisms used in the inoculation process. For example, he induced a mixed infection by inoculating an animal subcutaneously with the dead bacillary bodies of B. coli, B. typhosus, and Gärtner's bacillus. The blood tested against the same strains of the three microbes yielded an agglutinating reaction only towards B. typhosus and Gärtner's bacillus, not towards B. coli.

"X. coli-microbe" when the blood of an "X. coli-microbe immunised animal" fails to clump the same strain of B. typhosus which was used to immunise the original animal is a matter difficult of comprehension. Is it conceivable that the injection of living or dead typhoid cultures may lead to an exalted state of activity among certain strains of B. coli normally present in the intestine of the animal and induce a kind of coli infection?

In conclusion, I do not care to infer more than this:—Namely that those coli-like microbes which gave a positive reaction with Widal's test are of considerable scientific interest, and possibly above all their fellows were indicative of recent fouling with objectionable matters. It is not contended that they had their origin in cases of enteric fever, much less that they were possessed of specialised function in relation to the propagation of enteric fever.

Since this report was written, Dr. Horrocks' treatise on the bacteriological examination of water has been published. Dr. Horrocks gives a most interesting account of his study of coli-like micro-organisms in relation to the serum test. It is to be regretted that the limits of space prevent me from making more than a passing allusion to his important results.

(4) *Spores of B. enteritidis sporogenes* (Klein).—The results are shown in Table 9.

TABLE 9.

Description of the Sample of Waters.		Spores of B. enteritidis sporogenes (Klein) in:—		
		10 cc.†	100 cc.†	200 cc.†
Sample A¹, 18, High Street	October 15th, 1900 ..	-	-	-
Sample B¹ St. Pancras	October 15th, 1900 ..	-	+	+§
Sample C¹, 10, Oving Road	October 22nd, 1900 ..	-	-	-
Sample D¹, Cattle Market	October 22nd, 1900 ..	-	-	-
" D², " "	February 25th, 1901..	-	-	+¶
Sample E¹, 32, Bognor Road	October 30th, 1900 ..	-	-	-
Sample F¹, Ettrick Road	October 30th, 1900 ..	-	-	-
Sample G¹, 2, North Gate	November 5th, 1900..	-	-	-
" G², " "	January 14th, 1901 ..	-	-	-
" G³, " "	February 12th, 1901..	-	-	-
Sample H¹, 16, St. Pancras	November 5th, 1900..	-	-	-
" H², " "	January 14th, 1901 ..	-	-	-
" H³, " "	February 12th, 1901..	-	-	-

TABLE 9—*continued.*

Description of the Sample of Waters.		Spores of B. enteritidis sporogenes (Klein) in :— 10 cc.†	100 cc.†	200 cc.†
Sample I^1, 26, Chapel Street	November 13th, 1900	-	+*	+
" I^2, " "	December 10th 1900	-	-	-
" I^3, " "	February 25th 1901 ..	-	-	-
Sample J^1, 94, East Street	November 13th 1900	-	-	+
" J^2, " "	December 10th, 1900	-	-	-
Sample K^1, 7, 8, 9, Chapel Street ..	November 19th, 1900	-	-	-
" K^2, " " ..	November 27th, 1900	-	-	-
" K^3, " " ..	March 11th, 1901 ..	-	-	-
Sample L^1, 52, Victoria Road	November 19th, 1900	-	-	-
" L^2, " "	November 27th, 1900	-	-	-
" L^3, " "	March 11th, 1901 ..	-	-	-
Sample M^1, 160, Broyle Road	December 3rd, 1900..	-	-	-
" M^2, " "	January 21st, 1901 ..	-	-	-
" M^3, " "	March 25th, 1901 ..	-	-	-
Sample N^1, 86, North Street	December 3rd, 1900..	-	-	-
" N^2, " "	January 21st, 1901 ..	-	-	-
" N^3 " "	March 25th, 1901 ..	-	-	-

§ ¶ * In each case 1 cc. of the culture killed a guinea-pig in 24 hours.
††† Pasteur "filter brushing" method.

Of these thirty samples of water none yielded a positive result with 10 cc. Two (D^2 and J^1) gave a positive result with 200 cc. but not with 100 cc., and two (B^1 and I^1) yielded a positive result with 100 cc. but not with 10 cc. It will thus be seen that the samples were remarkably free from the spores of this pathogenic anaërobe.* These well waters contained little or no suspended matter, and I have for long suspected that the spores of B. enteritidis sporogenes tend to be associated with small particles. Indeed fragments of organic and inorganic matter are apt, in my opinion, to act as carriers from one place to another of bacterial spores in general. It was not of course to be anticipated that the waters would contain spores of B. enteritidis in any considerable number, since pure waters may yield negative results even with 500 cc. But in relation to the B. coli results it might perhaps have been expected that a greater number of samples should have given a positive result with 100 cc. than actually

* Fig. 15, Plate XXVII.

turned out to be the case. If, however, the tentative view I have advanced be correct, it is easy to conjecture the possibility or probability of the spores of B. enteritidis sporogenes being held back to some extent in the interstices of the soil while other bacteria of non-sporing sort escaped into the well water. Further, the spores more than the bacilli would be apt in still water to settle to the foot of the well or cling to its sides. A comparison of diagrams that I made in this connection served to show that there is no necessary parallelism between total number of bacteria and the presence or absence of B. enteritidis sporogenes. For example, I^1 contained the spores of this anaërobe in 100 cc. and I^2 yielded a negative result with 200 cc. Yet the former sample contained 338 bacteria and the latter 9,880 respectively per cc. Again, D^2 and J^1, which gave positive results, were by no means conspicuous as regards total number of bacteria. Notwithstanding the undoubted value of this test in the bacterioscopic analysis of water, I am inclined to think that a nice judgment is sometimes required in interpreting results. For example, in the presence of much suspended matter, and in the absence of other bacteriological data pointing to recent animal pollution, some caution should be exercised before condemning a water on account of the mere presence of B. enteritidis sporogenes. Flood water is a case in point because it contains much suspended matter, which is objectionable or relatively harmless according to its derivation. Such water may be judged of by other bacteriological tests, tests capable of yielding evidence of recent and therefore specially dangerous contamination. But in the absence (relatively speaking) of suspended matter and in the presence of bacteria seemingly of objectionable sort the concomitant presence of B. enteritidis sporogenes even in sparse amount is apt to be specially significant. Nor can its absence even from a large bulk of water in these cases be considered conclusive proof of harmlessness of the water. Where the line should be drawn involves the question of standards, and although I have had some experience of the bacteriological examination of soils, waters, and sewage, I hesitate to touch on this matter. This much may be said without any danger of raising points open to controversy. The spores of B. enteritidis sporogenes are present in $\frac{1}{100}$ to $\frac{1}{1000}$ cc. of sewage. In virgin soils this microbe has a sparse distribution, but in polluted and cultivated soils it is present in great abundance (1,000 to 10,000 per gramme). Pure waters may contain no spores even in 100—500 cc. or more of the sample. Speaking in general terms, a reasonable view would seem to be this—a potable water should be condemned if it contains B. enteritidis sporogenes in 10 cc., and regarded with suspicion* if this microbe is present even in 100 cc. Absence of B. enteritidis sporogenes from 100 cc. implies *relative* safety, but absence from even 200 cc. need not necessarily in all cases be accepted as indicating absolute freedom from danger of a potential if not actual kind. In the present case, and assuming that my conjectures as regards the association of suspended matters and the spores of bacteria be correct, the absence of

* Not perhaps always condemned if other bacteriological tests give no indication of recent fouling with animal matters.

B. enteritidis sporogenes even from 200 cc. of most of the Chichester well waters need not be accepted as conclusive proof of their purity but only of their relative harmlessness.

(5) *Streptococci.*—The results are shown in Table 10.

TABLE 10.

Description of the Samples of Water.		Presence (+) or absence (−) of streptococci in 10 cc. (0·1 cc. of a 10 cc. "filter brushing" of 1,000 cc.). Agar plate cultures at 37°C.
Sample A[1], 18, High Street ..	October 15th, 1900	+* Streptococcus 3.
Sample B[1], St. Pancras	October 15th, 1900	+ Streptococci 1 and 2.
Sample C[1], 10, Oving Road.. ..	October 22nd, 1900	−
Sample D[1], Cattle Market	October 22nd, 1900	−
" D[2], " "	February 25th, 1901 ..	−
Sample E[1], 32, Bognor Road ..	October 30th, 1900	−
Sample F[1], Ettrich Road	October 30th, 1900	−
Sample G[1], 2, North Gate	November 5th, 1900 ..	−
" G[2], " "	January 14th, 1901	−
" G[3], " "	February 12th, 1901 ..	−
Sample H[1], 16, St. Pancras.. ..	November 5th, 1900 ..	−
" H[2], " "	January 14th, 1900	−
" H[3], " "	February 12th. 1901 ..	−
Sample I[1], 26, Chapel Street ..	November 13th, 1900 ..	+ Streptococci 4 and 5.
" I[2], " " ..	December 10th, 1900 ..	+ Streptococcus 9.
" I[3], " " ..	February 25th, 1901 ..	−
Sample J[1], 94, East Street	November 13th, 1900 ..	?− [Microbe 6.]
" J[2], " "	December 10th, 1900 ..	−
Sample K[1], 7, 8, 9, Chapel Street..	November 19th, 1900 ..	−
" K[2], " " " ..	November 27th, 1900 ..	−
" K[3], " " " ..	March 11th, 1901	−

* From a gelatine not an agar plate.

TABLE 10—*continued.*

Description of the Samples of Water.		Presence (+) or absence (−) of streptococci in 10 cc. (0·1 cc. of a 10 cc. "filter brushing" of 1,000 cc.). Agar plate cultures at 37°C.
Sample L^1, 52, Victoria Road ..	November 19th, 1900 ..	−
" L^2 " " " ..	November 27th, 1900 ..	−
" L^3, " " " ..	March 11th, 1901	−
Sample M^1, 160, Broyle Road ..	December 3rd, 1900 . ..	+ Streptococci 7 and 8.
" M^2, " " " ..	January 21st, 1901	−
" M^3. " " " ..	March 25th, 1901	?− [Microbes 10, 11, 12.]
Sample N^1, 66, North Street ..	December 3rd, 1900.. ..	−
" N^2, " " ..	January 21st, 1901	−
" N^3 " " ..	March 25th, 1901	−

It will be seen that 23 out of the 30 samples of water yielded negative results with 10 cc. Two samples (J^1 and M^3) yielded a negative result with a query; the remaining five samples (A^1, B^1, I^1, I^2, and M^1) gave a positive result. Samples B^1, I^2, and M^1, it will be remembered, were conspicuous for abundance of micro-organisms. But A^1 and I^1 did not contain a very large number of microbes; not nearly so many, for instance, as N^1 and N^2, which yielded negative results as regards streptococci. So that mere numbers of total microbes would not seem to be necessarily a reliable guide in respect of the presence or absence of streptococci. In previous reports the significance of the presence of streptococci in potable waters has been fully dealt with. It has been pointed out that their *absence* need not necessarily imply "purity or safety," but that their *presence* is significant of animal pollution of recent sort. According to this view Samples A^1, B^1, I^1, I^2, and M^1 showed evidence of recent fouling with matters of intestinal outcome.*

Since this report was written, Dr. Horrocks' treatise on the bacteriological examination of water has been published. Dr. Horrocks agrees with my view of the value of the streptococcus test as indicating sewage pollution but differs from my contention that the presence of streptococci in any number indicates recent, and, therefore, dangerous contamination. While not agreeing with him in this matter his opinion is certainly worthy of full consideration, especially since his own conclusions are advanced in a spirit of moderation. Questions of space alone prevent me from doing full justice to his work in this connection.

* Figs. 1, 2, 3, 4, Plate XXIII., and Figs. 5, 6, 8, Plate XXIV., and Figs. 9, 10, 11, 12, Plate XXV.

[I am much indebted to Dr. Albert Norman for the excellent skill he has shown in photographing my preparations.]

The following is a brief description of the streptococci isolated from the well waters :—

Name.—STREPTOCOCCUS 1.

Source.—0·1 cc. of a 10 cc. "filter brushing" of 1,000 cc. Sample B[1]. Agar plate culture (37° C.).

Morphology.—Stains by Gram's method. Chains of medium length.*

Agar plate cultures at 37° C. (under a low power of the microscope).—Colonies minute, transparent-looking, more or less circular in shape, faintly granular with *clean* edge.

Gelatine plate cultures at 20° C. (under a low power of the microscope).—Colonies extremely minute and transparent-looking, and of somewhat irregular shape. Very faintly granular, and some present a nucleated appearance.

Gelatine oblique cultures at 20° C.—Small transparent-looking colonies. No liquefaction.

Broth cultures at 37° C.—Diffuse cloudiness.

Litmus milk cultures at 20° C.—No visible change.

Remarks.—Not found to be pathogenic in the case of mice.

Name.—STREPTOCOCCUS 2.

Source.—Same as 1.

Morphology.—Resembles 1, but chains are shorter.†

Agar plate cultures *Gelatine cultures* *Gelatine oblique cultures* *Broth cultures* *Litmus milk cultures*	Could not with any degree of certainty be differentiated from Streptococcus 1.

Remarks.—Two mice were inoculated subcutaneously from a broth culture. One died in eleven days, but the other remained quite unaffected.

Name.—STREPTOCOCCUS 3.

Source.—0·1 cc. of a 10 cc. "filter brushing" of 1,000 cc. Sample A[1] Gelatine plate culture at 20° C.

Morphology.—Stains by Gram's method. Immensely long chains of cocci.‡

Gelatine plate cultures at 20° C. (under a low power of the microscope).—Colonies larger than is usually found to be the case with streptococci; they are granular-looking and the edge is wavy.

Gelatine oblique cultures at 20° C.—Colonies grow more rapidly and are larger than most streptococci; they are granular and semi-transparent looking with a wavy edge. No liquefaction.

Broth cultures at 37° C.—Nearly transparent, with cirrhus-like growths floating throughout the medium, and at foot of tube stringy white growth.

Litmus milk cultures at 37° C.—Little or no visible change.

Remarks.—Although isolated from a gelatine plate culture it was found to grow well at 37° C.

* Fig. 1, Plate XXIII.
† Figs. 2 and 3, Plate XXIII.
‡ Fig. 4, Plate XXIII.

Name.—STREPTOCOCCUS 4.

Source.—0·1 cc. of a 10 cc. "filter brushing" of 1,000 cc. Sample I[1]. Agar plate culture (37° C.).

Morphology.—Stains by Gram's method. Chains of medium length, which tend to cohere together.*

Gelatine plate cultures at 20° C. and *Agar plate cultures at* 37° C.—The colonies are of the usual streptococcus type, being small and transparent-looking and of slow rate of growth.

Broth cultures at 37° C.—Diffuse cloudiness with cirrhus-like growths on the sides and foot of tube.

Litmus milk cultures at 37° C.—Fairly strong acid but no clot (fourth day).

Remarks.—Not found to be pathogenic to mice.

Name.—STREPTOCOCCUS 5.

Source.—Same as 4.

Morphological and biological characters.—Could not be differentiated with any degree of certainty from Streptococcus 4. Non-pathogenic.†

[Microbe 6.]—It was difficult to decide whether this microbe was a streptococcus or not. On the whole best considered not with a query.‡

Name.—STREPTOCOCCUS 7.

Source.—0·1 cc. of a 10 cc. "filter brushing" of 1,000 cc. Sample M[1]. Agar plate cultures (37° C.).

Morphology.—Stains by Gram's method. Chains usually short, but some of medium length.§

Gelatine plate cultures at 20° C.—Small transparent-looking colonies. No liquefaction.

Broth cultures at 20° C.—Diffuse cloudiness.

Litmus milk cultures at 37° C.—Acidity but no clot.

Remarks.—Non-pathogenic in mice.

Name.—STREPTOCOCCUS 8.

Source.—Same as 7.

Morphology.—Stains by Gram's method. Short chains.‖

Biological characters.—Resembled Streptococcus 7 very closely. Two mice were inoculated subcutaneously, each with 1 cc. of a broth culture. One died on the sixth day, but the other remained apparently quite unaffected.

Name.—STREPTOCOCCUS 9.

Source.—0·1 cc. of a 10 cc. "filter brushing" of 1,000 cc. Sample I[2]. Agar plate culture (37° C.).

Morphology.—Stains by Gram's method. Fairly short chains.¶

Gelatine plate cultures at 20° C.—Minute transparent colonies of slow rate of growth. No liquefaction.

Broth cultures at 37° C.—Diffuse cloudiness.

Litmus milk cultures at 37° C.—Acidity but no clot.

[Microbes 10, 11, and 12.]—These microbes seemed to belong to the same species. Their relation to the class of streptococci was doubtful. They are entered in my records as negative with a query.

* Fig. 5, Plate XXIV.
† Fig. 6, Plate XXIV.
‡ Fig. 7, Plate XXIV.
§ Fig. 8, Plate XXIV., and Fig. 9, Plate XXV.
‖ Fig. 10, Plate XXV.
¶ Figs. 11 and 12, Plate XXV.

IV.—General summary of the chemical and bacteriological results obtained in this investigation :—

Chemical results.

None of the samples contained more than minute traces of free ammonia, and the figures as regards oxygen absorbed from permanganate were so small as to be negligible. None of the samples were open to any suspicion of danger as judged by the albuminoid ammonia test, and most of them could only be regarded as of great purity. Most of the samples contained no more, if as much, chlorine as might be expected from ordinary well waters. In a few cases only (M^1, M^2, M^3, K^1, K^2) was the amount perhaps excessive; in other few (A^1, D^2, and I^2) almost certainly suspicious. None of the samples could have been condemned in view of the standards usually adopted in regard of the free ammonia, albuminoid ammonia, or oxygen absorbed from permanganate. Possibly a few might have been rejected on the chlorine figures; but on the basis of this test alone chemists seem reluctant to pronounce an unfavourable opinion unless the amount is altogether excessive.

Bacteriological results.

The bacteriological results stand out in strong contrast to the chemical results. For while some of the samples (notably G^3, H^1, H^2, H^3, J^2, K^1, L^3, and (? N^1)) showed a high degree of apparent bacterial purity, and others (C^1, D^2, E^1, F^1, G^1, G^2, I^3, K^2, L^2, N^3) a degree of impurity so slight that it would have escaped recognition by methods less searching than those employed in the investigation, the remainder gave either definite evidence of objectionable, although not gross, pollution (A^1, J^1, K^3, L^1, M^3, N^2), or even distinct indication of seemingly dangerous fouling (B^1 (? D^1), I^1, I^2, M^1, M^2). Nevertheless, the "average bacterial quality," if such a term is permissible, of the well waters was at first sight surprisingly good. Although there was a certain parallelism between the total number of bacteria and the facts as regards gas-forming bacteria, B. coli B. enteritidis sporogenes, and streptococci, it is evident that to place too much reliance on this seeming coincidence would involve serious error in a number of cases.

The outstanding features of this bacteriological investigation appear to be the following :—The number of B. coli (and allied forms) were in the majority of samples in excess, either actually or in relation to the total bacterial flora; and a few of the samples contained streptococci and B. enteritidis sporogenes. The *mere presence* in *sparse amount* of these objectionable microbes does not perhaps wholly justify the bacteriologist in condemning a water. But when B. coli, for example, is present in a water sample in much greater numbers relative to the total bacterial flora than is reasonably looked for in the case of a water removed from all sources of objectionable contamination, a strong suspicion is

APP. B. No. 6. On the Chemical and Bacteriological Examination of Chichester Well Water; by Dr. Houston.

created that the sample is water that has been exposed to animal pollution. If this view be correct, the Chichester well waters may be regarded as subsoil waters contaminated with excremental matters which have been so modified by passage through the soil as to permit this water as obtained from the wells to *simulate* in some cases the purest water in other cases water of a moderate degree of purity. However this may be, in a few samples the bacteria of objectionable sort were present in sufficient abundance to leave no reasonable room for doubt that the samples were from definitely polluted wells.

In brief, these Chichester well waters in general were not remarkable so much as regards evidence of actual and unmistakeable harmfulness as on account of certain inherent biological qualities which suggested their evil origin—qualities masked to a considerable extent by the effects of filtration of the water through the soil.

It may be asked how far, if at all, do these results lend confirmation to Dr. Thomson's belief that the well waters could not be held to be largely responsible for the "continued prevalence of enteric fever in serious amount" in Chichester, and to his tentative hypothesis that soil played a part in "fostering and localising" the disease?

As regards the former, it has been pointed out that the samples of well water frequently contained extremely few bacteria, but that a majority of the samples contained bacteria of objectionable sort; usually, it is true, in sparse amount actually, but nevertheless seemingly in suspicious numbers relative to the total bacterial flora. Assuming the possibility or even probability of these well waters containing on occasion not only objectionable bacteria but also microbes of morbific quality, it is evident that at a given time the dose of poison in any but a large amount of the water would be apt to be small, and therefore correspondingly less dangerous.* To this extent the investigation did not point to the Chichester well waters being "heavily" implicated in the propagation of enteric fever, and Dr. Thomson was most careful not to deny the possibility of the disease being occasionally spread by this means. At this point and in this connection it is of interest to refer to the map accompanying this report. In the map each house invaded by enteric fever during the period May 28th, 1900, to June 5th, 1901 (both dates inclusive), is indicated by a

* Nevertheless although it is always wise to consider the amount of polluting material as strictly proportional to the degree of probable danger to health, the history of epidemics of waterborne disease does not seem to show that epidemics have been associated to the extent that might have been anticipated with gross pollution as compared with contamination of seemingly trivial sort. It is easy, of course, to understand why a pollution of apparently negligible amount but specific in character may be highly dangerous, while a contamination gross in amount but non-specific in character may be, comparatively speaking, unobjectionable. But it is difficult to escape the belief that there is something more than this—some conditions or sets of conditions of which we know nothing which serve to influence the morbific effect of a given dose of polluting material rendering it in some cases extremely dangerous, in others comparatively innocuous.

small black spot. The sites of the different wells (A to N) are marked by large coloured spots. Excluding well D, because it bore no near relation to dwelling-houses (being situated in an open space in the cattle market), it is to be noted that nearly one-half of the wells (M, A, I, H, C, E) bore a close topographical relation to recent occurrence of enteric fever. The remainder (B, F, L, J, N, K, G) showed no such topographical relationship. It needs to be emphasised that the wells chosen for examination formed but a part of the total number, and that they were not chosen haphazard, but purposely selected as far as possible because enteric fever had recently occurred in their immediate vicinity. That more of them were not wells associated as regards locality with enteric fever was chiefly due to the fact that the number of available closed pump wells was very limited.

While some of these six wells (M, A, I, H, C, E) were conspicuous as regards evidence of objectionable pollution (notably M and I), others were by no means remarkable in this respect (notably H); and some of the seven wells (B, F, L, J, N, K, G) were open to much suspicion of objectionable pollution (notably B). Nevertheless there can be no doubt that the six wells (M, A, I, H, C, E), when compared with the seven wells (B, F, L, J, N, K, G), show, on an average, greater signs of pollution.

The dates of notification of the enteric fever cases occurring in the immediate vicinity of the wells M, A, I, H, C, E, and the dates of the collection of Samples M^1, M^2, M^3, A^1, I^1, I^2, I^3, H^1, H^2, H^3, C^1, E^1, are given in the following table (Table 11.) :—

TABLE 11.

Showing the dates of notification of enteric fever cases occurring in the immediate vicinity of wells M, A, I, H, C, E, and the date of collection of Samples M^1, M^2, M^3, A^1, I^1, I^2, I^3, H^1, H^2, H^3, C^1, E^1.

Well.	Enteric Fever Cases.	Dates of Collection of Sample of Water.
M.	November 30th, 1900	M^1, December 3rd, 1900; M^2, January 21st, 1901; M^3, March 25th, 1901.
A.	July 2nd, 1900 (2 cases), and April 15th, 1901.	A^1, October 15th, 1900.
I.	June 18th, 1900	I^1, November 13th, 1900; I^2, December 10th, 1900; I^3, February 25th, 1901.
H.	June 27th, 1900	H^1, November 5th, 1900; H^2, January 14th, 1901; H^3, February 12th, 1901.
C.	May 28th, 1900, and June 5th, 1900	C^1, October 22nd, 1900.
E.	July 22nd, 1900	E^1, October 30th, 1900.

not inconsistent with the supposition that possibly the soil at Chichester fosters in a higher degree than most soils "the vitality and morbific power of the infective material of enteric fever."

(8) B. typhosus could not be found in any of the samples examined. But B. coli (or closely allied forms) was found in a majority of the waters; and further, a small percentage of these coli-like microbes gave a positive result with the agglutination test, with human typhoid blood, with the blood of a typhoid immunised guinea-pig, or with blood of both sorts.

ADDENDUM A.

Brief Summary of Dr. Lorrain Smith's Report* on the Epidemic of Typhoid Fever in Belfast, 1898.

Dr. Lorrain Smith's Report is a notable one in many respects, and deserves more than this passing mention. Whatever the judgment on his conclusions, the quantity of work he carried out and its valuable quality must appeal very strongly to all bacteriologists.

A serious outbreak of enteric fever was witnessed in Belfast in March, 1897. In January, 1897, three or four cases of typhoid fever occurred in a farm on the Stoneyford catchment area. Portions of the discharges of these fever patients were thrown into a manure heap, the liquid from which passed into the adjoining stream and thence into the Belfast water supply. From an inspection of the local conditions Dr. Smith came to the conclusion that the farm cases were not only a possible source of infection of the water, but that in all probability they were the actual cause of the outbreak.

As regards his arduous bacteriological investigations, Dr. Lorrain Smith found that he was able to isolate races of B. coli from the spleen of typhoid patients which reacted to Widal's test; whereas a large number of coli-like bacilli obtained from a healthy intestine gave uniformly negative results. Further, although he failed to isolate from the implicated water B. typhosus he succeeded in separating from it coli-like microbes which reacted in marked fashion with the blood of the typhoid patients believed to have contracted the disease through drinking the same water.

His conclusions were:—

(1) In the presence in the water of typical bacilli of the coli communis group, we find evidence of its contamination with intestinal excreta.

(2) Certain of these bacilli exhibit their relationship to the process of infection in typhoid fever. (*a*) by their lethal effect on small animals, (*b*) by showing the reaction of infection when exposed to the blood of typhoid patients.

As regards (1), the author seems to lay too much stress on the mere presence of B. coli irrespective of its relative abundance, it is by no means easy to define the qualities which go to constitute what Dr. Lorrain Smith calls typical B. coli.

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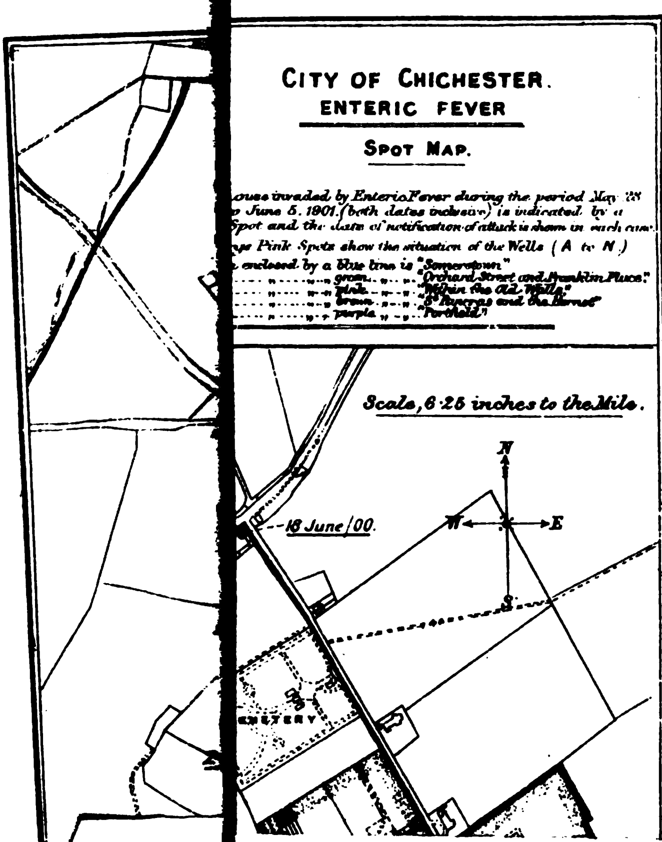
* "Report on the Epidemic of Typhoid Fever in Belfast, 1898." By J. Lorrain Smith, M.A., M.D.


CITY OF CHICHESTER.
ENTERIC FEVER
SPOT MAP.
ouse invaded by Enteric Fever during the period May 28
o June 5. 1901. (both dates inclusive) is indicated by a
Spot and the date of notification of attack is shown in each case.
ge Pink Spots show the situation of the Wells (A to N.)
enclosed by a blue line is "Somerstown"
green "Orchard Street and Franklin Place."
pink "Within the Old Walls."
brown "St Pancras and the Hornet"
purple "Portfield"
Scale, 6·25 inches to the Mile.
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18 June/00.
EMETERY

APP. B, No. 6.

On the Chemical and Bacteriological Examination of Chichester Well Water; by Dr. Houston.

It will be seen that nearly all the samples were collected some considerable time *after* the cases of enteric fever had occurred. This, however, was not the case as regards M well; and it is noteworthy that M^1 was rich in coli-like microbes and contained streptococci as well. M^2 was also conspicuous as regards B. coli, and M^3 contained many coli-like microbes in 10 cc. of the water.

As regards Dr. Thomson's tentative hypothesis that soil played a part in "fostering and localising" typhoid fever in Chichester, I am inclined to think that these results lend some support to his views. For I have already pointed out that the well water represents the subsoil water, and that the subsoil water represents the "washings" of soil more or less perfectly filtered. Moreover, while it is true that some of the samples of this soil water showed no signs of impurity, and others gave only bare indication of the presence of objectionable contamination there can be no doubt that the majority were open to suspicion, and that a few were obviously polluted. Of certain intrinsic biological qualities seemingly possessed by these waters which served to differentiate them from pure waters notwithstanding the limited total number of microbes usually present, I have already spoken at some length. These qualities were masked as I think by the mechanical filtering action of the soil, but not to such an extent as wholly to prevent useful conclusions being drawn regarding the probable objectionable origin of some of the bacteria present in the well waters. These qualities, moreover, are the reverse of inconsistent with the supposition that the soil at Chichester fosters in a higher degree than most soils "the vitality and morbific power of the infective material of enteric fever;" the deeper layers of soil, that is, for in my judgment the balance of evidence is against the long persistence of B. typhosus in the surface layers of soil. By what means the virus of enteric fever can be conveyed from the *deeper* layers of soil to the individual other than through water supply is a difficult question. Nor does Dr. Thomson touch on this matter in his report. But probably he has preception even under these circumstances of modes of the conveyance of infection not obvious at first sight, and almost certainly I think he includes in his conceptions the *surface* layers of soil, which would lighten the task of linking together the saprophytic and parasitic phases of B. typhosus.

FINAL CONCLUSIONS.

A. *Chemical.*

None of the thirty samples of Chichester well water could reasonably have been condemned on the basis of the free ammonia, albuminoid ammonia, or oxygen absorbed from permanganate tests. Nearly all of them would have been classed as of great organic purity, though the amount of chlorine in a number of samples was perhaps suspicious.

B. *Bacteriological.*

1. The *general results and inferences* are as follows :—

(*a*) *Total number of bacteria per cc*:—In 3 samples, 1,000 but less than 10,000; in 13 samples, 100 but less than 1,000; in 11 samples, 10 but less than 100; in 3 samples, less than 10.

(*b*) "*Gas*" *in gelatine* "*shake*" *cultures* (24 hours at 20° C.)—In 2 samples, + 10 cc. — 1 cc.; in 6 samples, + 100 cc. — 10 cc.; in 22 samples, — 100 cc.

(*c*) *B. coli* (*and allied forms*).—In 6 samples, + 0·1 cc.; in 6 samples, + 10 cc. — 0·1 cc.; in 10 samples, + 100 cc. — 10 cc.; in 8 samples, — 100 cc.

(*d*) *Spores of B. enteritidis sporogenes* (Klein).—In 2 samples, + 100 cc. — 10 cc.; in 2 samples, + 200 cc. – 100 cc.; in 26 samples, — 200 cc.

(*e*) *Streptococci.*—In 5 samples, + 10 cc.; in 25 samples, — 10 cc.

(2) These general results *may* be interpreted as indicating nothing more than that some of the waters were polluted and that others were of great bacterial purity.

(3) But it may be questioned whether they do not indicate something more than this; namely, that the waters in general were possessed of intrinsic biological qualities pointing to their late association with matters of intestinal sort.

(4) Biological qualities such as the above are not proper to waters derived from pure sources; moreover they are apt to be masked chemically by the mechanical filtering action of the soil.

(5) If this view be correct, immunity from danger in drinking such waters would be relative, not absolute.

(6) The circumstance that the inhabitants of Chichester drawing their water supply from these local wells have not seemingly suffered to any conspicuous extent from enteric fever in the past, may possibly be referred, not to the complete absence of dangerous pollution of well waters, but to the beneficial mechanical action of the soil in reducing the amount of morbific poison contained in the soil water.

(7) The facts observed by me at Chichester lend some support to Dr. Thomson's tentative hypothesis that soil plays some part in "fostering and localising" enteric fever in this town, inasmuch as the well waters representing the more or less perfectly filtered "washings" of soil nevertheless possessed certain biological qualities suggestive of fouling with matters of intestinal outcome. Qualities

not inconsistent with the supposition that possibly the soil at Chichester fosters in a higher degree than most soils "the vitality and morbific power of the infective material of enteric fever."

(8) B. typhosus could not be found in any of the samples examined. But B. coli (or closely allied forms) was found in a majority of the waters; and further, a small percentage of these coli-like microbes gave a positive result with the agglutination test, with human typhoid blood, with the blood of a typhoid immunised guinea-pig, or with blood of both sorts.

ADDENDUM A.

Brief Summary of Dr. Lorrain Smith's Report* on the Epidemic of Typhoid Fever in Belfast, 1898.

Dr. Lorrain Smith's Report is a notable one in many respects, and deserves more than this passing mention. Whatever the judgment on his conclusions, the quantity of work he carried out and its valuable quality must appeal very strongly to all bacteriologists.

A serious outbreak of enteric fever was witnessed in Belfast in March, 1897. In January, 1897, three or four cases of typhoid fever occurred in a farm on the Stoneyford catchment area. Portions of the discharges of these fever patients were thrown into a manure heap, the liquid from which passed into the adjoining stream and thence into the Belfast water supply. From an inspection of the local conditions Dr. Smith came to the conclusion that the farm cases were not only a possible source of infection of the water, but that in all probability they were the actual cause of the outbreak.

As regards his arduous bacteriological investigations, Dr. Lorrain Smith found that he was able to isolate races of B. coli from the spleen of typhoid patients which reacted to Widal's test; whereas a large number of coli-like bacilli obtained from a healthy intestine gave uniformly negative results. Further, although he failed to isolate from the implicated water B. typhosus he succeeded in separating from it coli-like microbes which reacted in marked fashion with the blood of the typhoid patients believed to have contracted the disease through drinking the same water.

His conclusions were :—

(1) In the presence in the water of typical bacilli of the coli communis group, we find evidence of its contamination with intestinal excreta.

(2) Certain of these bacilli exhibit their relationship to the process of infection in typhoid fever, (*a*) by their lethal effect on small animals, (*b*) by showing the reaction of infection when exposed to the blood of typhoid patients.

As regards (1), the author seems to lay too much stress on the mere presence of B. coli irrespective of its relative abundance, it is by no means easy to define the qualities which go to constitute what Dr. Lorrain Smith calls typical B. coli.

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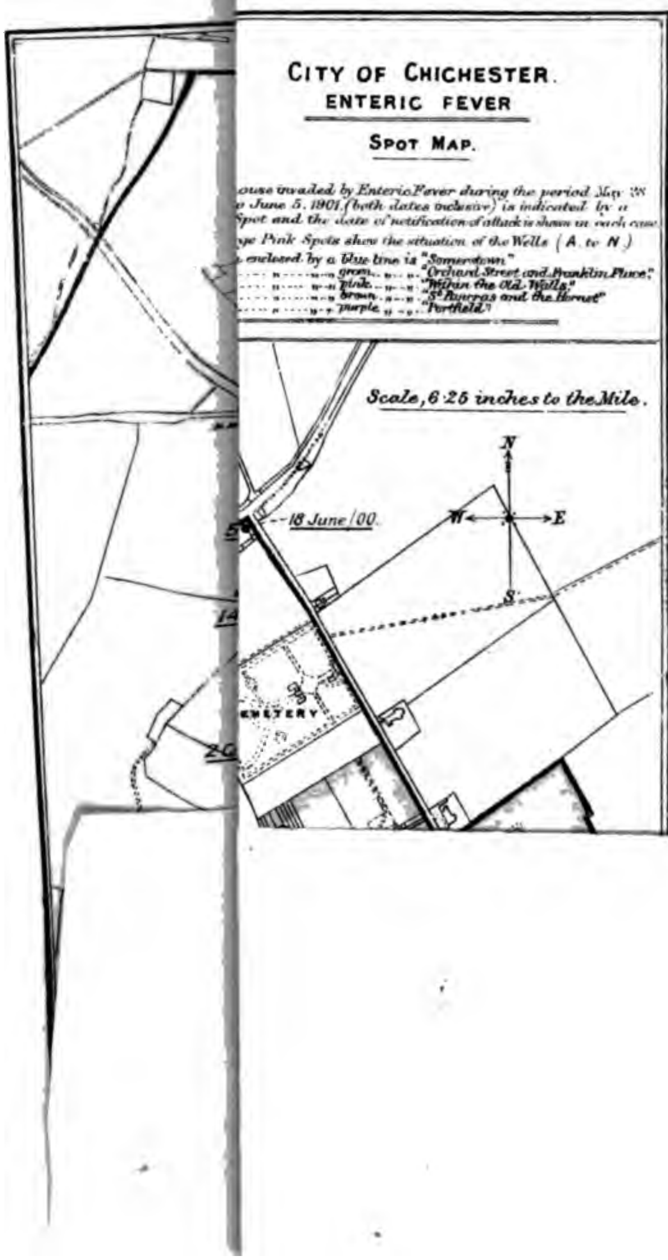
* "Report on the Epidemic of Typhoid Fever in Belfast, 1898." By J. Lorrain Smith, M.A., M.D.


CITY OF CHICHESTER.
ENTERIC FEVER
SPOT MAP.
ouse invaded by Enteric Fever during the period May 28
o June 5, 1901 (both dates inclusive) is indicated by a
Spot and the date of notification of attack is shown in each case
ge Pink Spots show the situation of the Wells (A. to N.)
enclosed by a blue line is "Somerstown"
green "Orchard Street and Franklin Place"
pink "Within the Old Walls"
brown "St Pancras and the Hornet"
purple "Portfield"
Scale, 6·25 inches to the Mile.
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As regards (2), while it may be admitted that a pathogenic B. coli is more significant than a non-pathogenic one, it must be remembered that not only have races of B. coli isolated from sources which are to be regarded as highly objectionable not uncommonly been found to be non-pathogenic, but also that strains of B. coli obtained from situations which, in comparison, are to be thought of as *relatively* harmless, have, in a number of instances, been proved to be lethal in their effects on animals. It may be questioned indeed whether the clumping reaction necessarily indicates a relationship to the process of infection in typhoid fever.*

The author seems to be strongly biassed in favour of the views of Chantemesse and Widal, namely, "That polluted waters owe their power to produce typhoid infection in a large measure to the presence of the coli bacilli." Of late years we have come to learn, that the urine, in some cases, of enteric fever may contain B. typhosus in numbers inconceivably great, and in practically pure culture. Surely such a urine in morbific quality is as potent, notwithstanding the comparative absence of B. coli, as the stools of the same patient, which, besides containing B. typhosus, would also contain B. coli in great abundance.

It may be admitted that a coli-like microbe which is pathogenic and clumps with typhoid blood is more significant, as regards animal and recent pollution, and possibly also as regards morbific if not specific enteric pollution, than B. coli, which is non-pathogenic and gives a negative result with Widal's test, is. But Dr. Lorrain Smith seems to go further than this, by implication if not by direct statement. To all intents and purposes he seems to regard such a coli-like microbe as possessed of some specific quality in relation to the propagation of enteric fever, and not merely as a micro-organism indicative above all its fellows of the possible concomitant presence of the virus of typhoid fever.

Nevertheless, Dr. Lorrain Smith's report disarms any criticism unless of a favourable character by reason of the quantity of work he carried out and its original and able quality. And possibly, although certainly unwittingly, I may have misapprehended his deductions and interpretated his inferences in an erroneous fashion. It must always be remembered that knowledge is progressive, and that hypotheses, perhaps fully warranted at the time they were advanced, may, in the light of fresh discoveries or new ways of looking at the old ones, seem less attractive.

It was largely the result of a study of Dr. Lorrain Smith's report that induced me to devote so much time and labour to the study of the coli-like microbe present in the Chichester well waters.

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* Dr. Schölberg supplies me with the following interesting note :—"A patient *before* inoculation with Wright's typhoid vaccine, had his blood tested against a strain of B. coli isolated from an abscess The agglutination phenomenon was positive, 1 : 20 dilution. With the onset of the typhoid reaction *after* inoculation the coli-clumping reaction gradually fell to zero (negative result, 1 : 10 dilution).

APP. B, No. 6.

On the Chemical and Bacteriological Examination of Chichester Well Water; by Dr. Houston.

ADDENDUM B.

SUB-SOIL WATER LEVELS (FEET ABOVE ORDNANCE DATUM) AND RAINFALL AT CHICHESTER, APRIL 30TH, 1900, TO MAY 6TH, 1901 (BOTH DATES INCLUSIVE).

Date.		Inches Rain.	Well 1.	Well 2.	Ballast Hole.	Well 3.	Well 4.	Well 5.
	1900.							
April	30	Nil	42·64	39·51	36·99	32·37	31·41	33·88
May	7	·35	41·89	38·97	36·66	32·20	31·24	33·55
„	14	Nil	40·39	38·18	36·29	32·03	31 03	33·34
„	21	Nil	39·48	37·51	35·83	31·87	30·82	32·71
„	28	·67	39·14	37·01	35·41	31·66	30·62	32·51
June	5	·21	38·31	36·43	34·79	31·44	30·41	32·00
„	11	·13	38·06	36·09	34·54	31·37	30·20	31·76
„	1	1·11	37·70	35·80	34·08	31·20	29·99	31·54
„	25	1·61	37·56	35·68	33·91	31·20	29·99	31·34
July	.. .. ..	·19	37·23	35·39	33·58	30·99	29·87	31·01
„	9	·52	36·89	35·22	33·04	30·95	29·62	30·80
„	16	Nil	36·77	35·01	32·66	30·74	29·32	30·72
„	23	·05	36·56	34·84	Dry at Gauge Point.	30·62	29·16	30·26
„	30	·33	36·23	34·55		30·41	28·95	29·92
August	7	1·16	36·06	34·39	—	30·37	28·78	29·76
„	14	·28	35 77	34·30	—	30·24	28·74	29·51
„	20	·45	35·69	34·26	—	30·08	28·57	29·30
„	27	·40	35·39	34·18	—	29·91	28·32	29·09
September	3	·11	35·14	33·97	—	29·78	28·34	28·97
„	10	·02	35·00	33·80	—	29·62	28·16	28·72
„	17	Nil	34·64	33·64	—	29·54	27·99	28·59
„	24	Nil	34·48	33·51	—	29·37	27·82	28·51
October	1	·63	34·14	33·34	—	29·23	27·70	28·42
„	8	·70	33·94	33·01	—	29·16	27·66	28·34
„	15	Nil	33·81	32·89	—	29·03	27·57	28·22
„	22	·36	33·48	32·76	—	28·91	27·49	28·09
„	29	·73	33·14	32·55	—	28·87	27·41	27·97
November	5	1·19	33·14	32·42	—	28·70	27·41	27·97
„	12	·48	32·81	32 18	—	28·70	27·41	27·97
„	19	1·15	32·73	32·18	—	28·70	27·41	28·04
„	26	·47	32·48	32·05	—	28·70	27·32	28·01

SUB-SOIL WATER LEVELS—*continued.*

Date.	Inches Rain.	Well 1.	Well 2.	Ballast Hole.	Well 3.	Well 4.	Well 5.
1900.							
December 3	·58	32·35	31·84	—	23·70	27·32	27·97
" 10	1·22	32·39	31·97	—	28·87	27·37	28·09
" 17	·52	32·35	31·93	—	28·95	27·41	28·13
" 24	·45	32·35	31·93	—	28·87	27·45	28·13
" 31	1·06	32·60	32·14	—	28·99	27·57	28·22
1901.							
January 7	·10	32·98	32·43	—	29·20	27·65	28·30
" 14	·31	33·27	32·68	—	29·20	27·70	28·34
" 21	·26	33·48	32·76	—	29·12	27·74	28·38
" 28	·19	33·48	32·76	—	29·16	27·82	28·38
February 4	·57	33·60	32·80	—	29·16	27·82	28·42
" 11	Nil	33·69	33·01	—	29·41	28·07	28·67
" 18	·10	34·14	33·34	—	29·45	28·12	28·84
" 25	·10	34·39	33·47	—	29·41	28·12	28·88
March 4	·73	34·44	33·55	—	29·37	28·12	28·84
" 11	·58	34·64	33·68	—	29·45	28·12	28·84
" 18	·21	35·14	34·01	—	29·53	28·16	28·92
" 25	·39	36·10	34·51	—	29·58	28·16	29·01
April 1	·98	26·73	34·93	—	29·70	28·24	29·09
" 8	1·35	36·89	35·06	—	30·28	28·70	29·67
" 15	·90	38·35	35·89	32·74	30·74	29·24	30·34
" 29	·13	38·81	36·26	33·29	31·08	28·74	31·20
May 6	·01	38·98	36·51	33·66	31·28	30·07	31·67
			MAXIMUM HEIGHTS.				
February and March 1899..	—	45·98	40·76	37·28	32·66	31·87	34·47
" " 1900..	—	47·44	41·39	37·61	32·87	32·28	35·1[illegible]
May .. .. 1901..	—	39·89	37·82	34·62	31·70	30·45	32·22

No. 7.

App. B, No. 7.

On Infection of Mussels and Cockles with Typhoid Bacillus and Cholera Vibrio: by Dr. Klein.

Report on Experiments on Infection of Mussels and Cockles with the Typhoid Bacillus and with Koch's Cholera Vibrio; by Dr. E. Klein, F.R.S.

There has been accumulating of late a strong presumption that mussels, and particularly cockles, have been at times the means of conveying enteric fever to those who consumed them; that as distributors of the enteric fever contagium these bivalves may be as competent as oysters. *A priori* this was not to be expected, since the bivalves of different sorts being alike obtained from sewage polluted estuaries. Oysters being principally consumed in a raw condition would seem more liable to convey the contagium of enteric fever, than would mussels or cockles which are said to be consumed largely in a "cooked" state. There can indeed be little doubt that a large amount of these shell-fish, viz., mussels and cockles, are, before consumption, subjected to some kind of cooking; nevertheless there is likewise little doubt that a large number of them, particularly cockles, are consumed raw. Thus, I am assured by Mr. James Murie, Inspector of Fisheries on the Kentish coast—to whom my best thanks are due for valuable and ready help in procuring for me mussels and cockles in fine condition—that the eating of raw cockles is by no means a rare occurrence; that he has himself repeatedly seen, and frequently known, cockles to have been consumed just as they were gathered.

However, we will assume that the bulk of mussels and cockles gathered are before consumption subjected to "cooking." But however this may be, I have, as will be seen later on, devoted special attention in the course of my experiments to the subject of the validity of the "cooking" to which cockles and mussels are customarily submitted.

In the experiments which follow I have repeated with the mussels and cockles the experiments that were described in a former report as having been undertaken in regard of oysters, viz., experiments by which it was established that the oyster kept in sea water that had been deliberately infected with culture of the cholera vibrio or of the typhoid bacillus, retains for some days within its shell the microbes in question; that these can be again recovered from the mollusc by proper means of cultivation. The first experiments that were made in this respect were made with mussels and cockles which were procured for me by Dr. Thresh, County Medical Officer of Health, of Essex—to whom my best thanks are due—from the Essex coast. The materials reached my laboratory in a fresh and excellent condition.

Series I.

Experiment I.—Cholera Vibrio.

In a tank (No. 1) holding about five gallons of sea-water were deposited these samples of the above mussels and cockles; and

to this water there was then added an emulsion of the 24 hours' old agar culture of the cholera vibrio. Next day one mussel (No. 1) and one cockle (No. 1) were taken from this tank. They, as well as those left in the tank, looked quite lively, and on being touched closed firmly and rapidly.

The shells of the bivalves were well washed and brushed, and then well dried. Next, by means of a sterile instrument, the shell of both molluscs was carefully opened, the whole of each animal cut up, and the turbid fluid thus obtained sucked up into a glass pipette. Several drops from each of the two capillary pipettes were then inoculated in each instance into test tubes containing sterile peptone salt solution. The inoculated peptone tubes were then incubated at 37° C. After 24 hours' incubation both peptone tubes were turbid; film specimens were therefore made, and after drying and staining duly examined. They showed vibrios in almost pure culture. Next, from the above peptone cultures agar surface plates were made, one from the peptone tube of mussel No. 1, and another from the peptone tube of cockle No. 1. These agar plates having been incubated at 37° C. for 24 hours were inspected, and the following condition was found:—The agar plate of mussel No. 1 showed abundance of colonies, like those of the cholera vibrio, and on microscopic examination such colonies were found to be composed of that vibrio. The agar plate of cockle No. 1 showed also an abundance of colonies, all with few exceptions being those of the cholera vibrio. From both plates sub-cultures were then made:—(*a*) on agar streak; (*b*) in gelatine stab; and (*c*) in peptone salt solution. After due incubation they all showed the typical characters of growth of the cholera vibrio; the peptone sub-cultures moreover gave with sulphuric acid marked cholera red reaction. In addition to these sub-cultures the following test was made:—

A guinea-pig that had been previously treated by two subcutaneous injections of fair doses of living cholera culture (of the stock with which the above tank experiments were made) was made to furnish material for the serum test: A fortnight after the last injection of this animal a drop of its blood withdrawn from an ear vein was added to an emulsion made from the 24 hours' old growth of the stock cholera culture on the surface of agar. The proportion of blood added to emulsion was 1 of blood to 25 of emulsion. Arrest of movement of the vibrios and agglutination of them into large clumps was thereby effected within 15 minutes—complete agglutination in 10–15 minutes. This guinea-pig's blood was now tested on emulsions of agar cultures of the above mussel No. 1 and of the above cockle No. 1, the dilution being 1:25. The result was positive, agglutination was complete within 15 minutes; as a matter of fact the culture derived from cockle No. 1 gave complete agglutination in 5–10 minutes.

From this it is seen that both mussels and cockles sojourning for 24 hours in cholera-infected water may receive, and retain, within their shells the cholera vibrios in large numbers, and that these vibrios retain unimpaired their cultural and morphological characters: Also that such vibrios respond at once to the agglutinating power of the blood of a cholera-protected guinea-pig.

App. B, No. 7.

On Infection of Mussels and Cockles with Typhoid Bacillus and Cholera Vibrio: by Dr. Klein.

Experiment 2.—Cholera.

The above mussel and cockle, having been taken from tank No. 1, the first infected sea water was poured from it and well drained off, and a new lot of fresh sea water added. This was repeated the next day. One day after the last change, *i.e.*, three days since the bivalves had been placed in cholera infected tank, all the cockles were found open and dead, and of the mussels only one was found alive. This mussel, No. 2, was removed, well brushed and washed, and then dried. The shell was then opened and the interior cut up, the turbid fluid being sucked up into a glass pipette. Inoculation of peptone salt solution with several drops of the fluid was then made as in the former case, and the result was exactly the same as above, viz., recovery in abundance of the cholera vibrio. As before the vibrio responded to the necessary tests; in peptone subculture it gave pronounced cholera red with sulphuric acid; it was completely agglutinated in 5–10 minutes by the blood of the cholera protected guinea-pig.

It is thus seen that a mussel immersed for 22 hours in cholera infected water retained the vibrios for 48 hours after substitution of clean sea water from the infected sea water in which it had previously been placed.

SERIES II.

Experiment 3.—Typhoid bacillus.

Of the same consignment of mussels and cockles sent me by Dr. Thresh, others were placed into tank No. 2, holding also about five gallons of sea water. To this was added the emulsion of a 24 hours' old agar culture of the typhoid bacillus.

Next day one mussel (No. 1) and one cockle (No. 1) were taken out of the tank. These, as also the others remaining in the tank, looked quite lively, and when touched their shells firmly closed. Their shells were well washed and brushed and subsequently opened, and after cutting up the molluscs the turbid fluid was used in each instance for the inoculation of phenolated broth tubes. The broth, after incubation at 37° C. for 24 hours, was very turbid; and from it phenolated agar surface plates and ordinary gelatine surface streak cultures were now made. The former, after incubation at 37° C. for 24 hours, revealed numerous typical colonies of the enteric fever bacillus. The latter, after incubation at 20° C. for 24 hours, showed almost a pure culture from mussel No. 1, and a great deal of typhoid growth from cockle No. 1,—although here there was, in addition, some contaminating organism. Subcultures were made of the typical typhoid colonies from the phenol agar plates, and the result was as follows:—(*a*) In morphological respects and motility, and in respect of its growth in gelatine streak, stab, and on gelatine plates the microbe was exactly like the typhoid bacillus; (*b*) it produced acid (red) in litmus milk; (*c*) it did not curdle milk; (*d*) it did not produce indol in broth; (*e*) it did not produce

gas in gelatine or glucose gelatine; (*f*) its emulsion showed striking agglutination within a few minutes with typhoid blood 1 : 50 and 1 : 100.

There can, then, be no doubt that the microbe recovered from this mussel and from this cockle was the true typhoid bacillus the same that had been added originally to the sea water in the tank in which the molluscs had been kept.

On removing the above mussel and cockle (*i.e.*, after 24 hours) from the tank, the water was poured off and fresh sea water added; and the same process was repeated after another 24 hours. After a further 24 hours, *i.e.*, three days since the experiment commenced, another mussel (No. 2) and another cockle (No. 2) were taken out and dealt with as before, viz., washing, brushing and opening the shell, cutting up the animal, and using the turbid fluid for inoculation of phenol broth tubes. These phenol broth cultures, incubated at 37° C. for 24 hours, were found turbid, and from them phenol agar surface plates were made. These plates were incubated at 37° C. for 24 hours with the following results. In the case of the mussel No. 2 very numerous typhoid colonies appeared, but also some stray intruders; in the case of cockle No. 2 the plate was covered with typhoid colonies —was, in fact, practically a pure culture of typhoid bacilli. As before, all tests were applied, the diagnosis being confirmed in every respect. It remains to be added that the emulsion of the subculture of the cockle No. 2 agglutinated with typhoid blood (1 : 50) almost instantly; at any rate, within three minutes the agglutination was complete.

It follows, then, from this experiment that mussels and cockles that have sojourned for 24 hours in typhoid infected sea water, did not, after a further sojourn for 48 hours in clean sea water, become free of the typhoid bacilli they have taken up; that, in fact, in the particular case of the cockle their recovery in pure culture and in abundance was simply and easily achieved.

SERIES III.

Experiment 4.

I received through Dr. Bulstrode from Shoeburyness a consignment of mussels, which on arrival were found to be in good condition.

Some of these were placed in tank No. 1, others in tank No. 2, each of which tanks contained a bottom layer of sand and about five gallons of sea water. To tank No. 1 was added a recent culture of cholera vibrio, to tank No. 2 a recent culture of typhoid bacillus.

After 48 hours one mussel was taken out of each tank; these will be designated cholera mussel No. 1 and typhoid mussel No. 1 respectively. After brushing and washing them well, they were used in the same way as in the previous experiments, viz.,

the cholera mussel for infecting peptone salt solution, the typhoid mussel for infecting phenol broth.

The further procedures were exactly the same as in the former experiments, and with like positive results. Typical cholera cultures were recovered from the cholera mussel, and the vibrios gave positive response to the agglutination test. Typical typhoid cultures were recovered from the typhoid mussel, and positive result was obtained by the agglutination test.

These two experiments with the cholera and typhoid mussel served as control for the following experiments in which certain "cooking" procedures were sought to be imitated.

Experiment 5.

At the same time that the above mussels were selected for test, *i.e.*, 48 hours since the infection of the sea water of the tanks with cholera and typhoid culture respectively, other mussels were removed from the tanks, and, after having been brushed and washed, were placed in a heap in a shallow basin (one basin being used for cholera infected mussels, another for typhoid infected mussels), and boiling water was poured over each collection of molluscs. It was found that in this procedure the temperature of the water used fell to 63° C. in five minutes, and that while the mussels on the outer part of the heap opened and became coagulated immediately after the boiling water was poured over them, those at the bottom of the heap took a considerable time to do so; in fact a longer time than it took the water to reach 63° C., *i.e.*, more than five minutes.

From the mussels at the top as well as from those at the bottom of the basins, cultures were made both as regards cholera and as regards typhoid. The result was that while neither the cholera vibrios nor the typhoid bacilli were recovered from the former (top mussels) they were readily recovered from the latter (bottom mussels).

From this it is seen that merely pouring boiling water over a heap of mussels need not destroy either cholera or typhoid infection contained in them.

A consignment of fresh cockles having been received per Mr. Murie from Essex, these were dealt with in exactly the same manner as the mussels in Experiment 4.

Experiment 6.

The first cockles were taken out of the cholera-infected tank (No. 1) three days after infection. Some of these were used for control, while others were subjected to the influence of boiling water in exactly the same manner as Experiment 5. As a

result: From the uncooked cockles the cholera vibrio was readily recovered; and from the "cooked" cockles of the bottom layer the first peptone culture yielded in cover film specimens vibrios which in all morphological respects corresponded to the cholera vibrio. Owing, however, to the simultaneous presence in large amount of rapidly liquefying bacillus mesentericus the gelatine plates that had been made from the peptone culture became useless for the recovery of cholera colonies.

Experiment 7.

From the typhoid infected tank (No. 2) cockles were taken out three days after infection of the water; some were used as control "raw," the others for the "cooking" experiment. Both the interior of the "raw" cockle as well as the interior of the "cooked" cockle (of the bottom layer) readily yielded, by phenol broth culture and then by phenol agar subculture, the typhoid bacillus; the microbe answering every test, including the agglutination test with typhoid blood.

Experiment 8.

The typhoid-infected sea water of tank No. 2 was removed at the end of three days and replaced by fresh sea water. On the sixth day after the experiment began (*i.e.*, three days after change of the water) the cockles left in the tank were taken out and subjected to the "cooking" process. Four of the cockles of the bottom layer were then well washed and drained, and from their interior (stomach and alimentary canal) phenol broth cultures were made. These were all found turbid after 24 hours' incubation at 37°. With a trace of the turbid phenol broth, phenol agar surface plates were then made; and with the result that three of the four cockles yielded practically a pure plate of copious typhoid colonies—one only showed besides numerous typhoid colonies, also some colonies of proteus vulgaris. All morphological and cultural tests were applied, and the response to these was confirmative of the typhoid bacillus; the test with typhoid fever blood (1 blood to 50 emulsion of recent gelatine subculture) yielded positive result, complete agglutination in five minutes being established.

Series IV.

In previous experiments 7 and 8 it was found that the recovery of the typhoid fever bacillus was easily achieved from the interior of cockles that had been subjected to typhoid bacillus infected water even when this infected water had been replaced for three days by clean sea water; and that moreover this was the case even with the cockles of which the shell and outer surface of the animal itself had been subjected to the influence of boiling water. These results suggested the possibility of the bacillus in question undergoing direct multiplication within the body of the cockle. With

App. B, No. 7.

Infection of Mussels and Cockles with Typhoid Bacillus and Cholera Vibrio; Dr. Klein.

a view of determining this point the following experiments were made :—

Experiment 9.

A consignment of fresh cockles and sand, received from Mr. Murie, were placed in the sea water tank, which was infected with an emulsion from a recent agar culture of the typhoid bacillus. Two days later two cockles were taken out, well brushed, washed, and opened ; the interior of their shells was well washed, and all the fluid inside the shell was drained off. Then, by an incision, the interior of the animal was exposed, and with a drop of thick turbid fluid therefrom a surface phenol agar plate was made—by rubbing the drop by means of a sterile platinum spatula over the surface of the phenol agar set in a flat dish. After 48 hours' incubation at 37° C. the plates were inspected and examined with this result :—

The plate inoculated from one cockle showed a large number of colonies, all of the character of the typhoid fever bacillus ; the plate of the second cockle showed a fair number of colonies which proved to be those of the typhoid fever bacillus. There were no other colonies, both plates being in fact pure cultures of typhoid fever bacillus. All necessary tests were made and the diagnosis confirmed, agglutination of the emulsion of a recent gelatine subculture with enteric fever blood occurring almost instantly.

At the time that the two cockles above referred to were removed from the tank, *i.e.*, after 48 hours, the infected sea water of this tank was poured off and replaced by fresh sea water. Again two days later, this water was replaced by fresh sea water. One day later, *i.e.*, the sixth day since the experiment commenced, or three days after the first infected sea water was replaced by fresh sea water—two cockles were taken out, brushed, well washed, and opened, the interior of the shell being washed. An incision was then made into the stomach of the mollusc, a drop of turbid fluid was sucked up from it into a capillary pipette, and with this drop a surface phenol agar plate was made, one for each animal. The result was striking ; both the plates yielded pure cultures of the typhoid fever bacillus. In one plate the number of colonies although large was still countable, but in the other their number was so great that no counting could be made. Under the magnifying glass the colonies looked like those of typhoid bacillus. On making and examining fresh and stained cover-films from several colonies indiscriminately, and on making at the same time sub-cultures on gelatine, in milk and in broth, and testing these, this diagnosis was confirmed.

A recent gelatine surface sub-culture was used for testing the emulsion of the growth with enteric fever blood, the proportion of the latter to the former being 1 to 60. The result was that distinct clumping commenced within five minutes, the process being completed within 10 minutes.

Figs. 1 and 2, plate XXVIII., show the phenol agar surface plates made from the interior of the two cockles last mentioned. Seeing that these plates represent but a drop from the interior of cockles which had been for two days in typhoid bacillus infected sea water, and had then been for three further days retained in clean sea water, the great number of the typhoid bacilli thus shown to have been present in the interior of the animals is matter for surprise. Not only are we forced to admit that the transference of the molluscs into clean water failed to eliminate the embodied typhoid bacilli, but are led to infer also that these bacilli meanwhile actually increased in number within the bodies of the cockles. As a matter of fact fig. 2, and to a lesser degree fig. 1, show crowds of colonies far in excess of those obtained from the two cockles in the antecedent experiments, *i.e.*, those examined directly after two days' sojourn in typhoid bacillus infected sea water.

No. 8.

APP. B, No 8. — On the use of Carbonic Oxide for Destroying Rats on Plague-infected Vessels; by Dr. J. Haldane, F.R.S.

Preliminary Report on the Use of Carbonic Oxide for Destroying Rats on Plague-Infected Vessels; by Dr. J. Haldane, F.R.S.

I beg to report that, in accordance with the request communicated to me by the Medical Officer of the Local Government Board, I have carried out a preliminary series of experiments on an apparatus capable of being used for the purpose of destroying rats on plague-infected vessels by means of carbonic oxide.

The reasons which, as was pointed out to me by the Medical Officer, render it probable that carbonic oxide may prove a suitable agent for destroying rats are (1) that carbonic oxide, being a gas, is capable of being blown through all parts of a vessel before cargo is broken, and therefore before any rats escape to the shore; (2) that it stupefies and kills the rats without first alarming them, so that they are not likely to attempt to jump overboard when the gas is blown in. As, moreover, carbonic oxide, unlike ordinary disinfectants, has no smell and no chemical action on any ship's fitting or substance carried as cargo, it can be applied without doing any damage.*

Proposed method of applying Carbonic Oxide.

The method which I propose for applying the carbonic oxide is briefly as follows:—When a vessel suspected to be plague-infected comes into dock, and the passengers, if any, have been discharged, a barge containing the necessary apparatus is brought alongside, and air containing a poisonous admixture of carbonic oxide is blown through each hold, the air entering through a ventilator opening into the hold in its upper part, and passing out either through openings in the lower part into the next hold, or through a ventilator, the opening of which is at the bottom of the hold, and if possible on the opposite side of the vessel. The tarpaulins covering the hatches are not removed until the operation is complete. The fore-peak, store-rooms, cabins, and any other spaces where rats might be present are similarly treated. The poisonous air is afterwards blown out with pure air, and the hatches, &c., opened to allow any remnants of the gas to escape. The crew have been mustered on deck before the carbonic oxide is driven in, and they are kept in the open air until any risk of poisoning is at an end.

The carbonic oxide is generated by blowing air (with or without an admixture of steam) through a deep bed of incandescent coke or anthracite contained in a special furnace. The carbonic acid at first formed when the oxygen of the air comes into contact with the coke is reduced more or less completely to carbonic oxide, while the nitrogen passes through unaltered. The resultant mixture (known as "producer" gas) contains nearly 30 per cent.

* Mr. Andrew Gibb informs me that an old and very successful plan of destroying rats in the holds of empty vessels is to light a charcoal fire in each hold and close the hatches. The rats are killed by the carbonic oxide formed.

of carbonic oxide and 70 per cent. of nitrogen, although a little carbonic acid, hydrogen, and sulphuretted hydrogen are also present. The gas is passed through a purifier, and then joins a much larger current of pure air, in which it passes on through flexible pipes to the vessel's hold. The mixture of air and producer gas contains about 1·5 per cent. of carbonic oxide. Both the main air-current and the air-current through the furnace are produced by means of "exhausters" run from the same engine, the object of using exhausters rather than fans being to ensure, in spite of varying back pressure, a definite volume and definite mixture of producer gas and air, and to obviate all danger of the mixture becoming too dilute to kill the rats, or so strong as to be explosive. The apparatus must be capable of delivering at least 100,000 cubic feet of air per hour, so that an ordinary hold full of cargo can be filled with poisonous air in about half an hour.

Carbonic oxide is present in ordinary lighting gas and in water gas, either of which might be used for the purpose of killing rats. Lighting gas, however, would not give a sufficiently poisonous mixture which was not also explosive; water-gas would not give a very large margin of safety; while the "producer" gas recommended forms with air an intensely poisonous mixture, which is at the same time very far from being either explosive or inflammable. The proportion of carbonic oxide in the mixture to be sent into the ship's hold is 1·5 per cent., while the smallest proportion required to form an inflammable mixture is 13 per cent., or about nine times as much.

The "producer" gas used must be purified, for the reason that in the crude state it contains a little sulphretted hydrogen (which might blacken the paint in a cabin and tarnish metal work) and smoke (which might injure certain cargoes, such as tea).

For rapidly testing the mixture used, and ascertaining that all the poisonous gas has been blown out, a small apparatus, capable of ready and certain use, can be employed. The presence of poisonous air at any point can also be easily ascertained by the use of a small animal such as a mouse or small bird, either of which is far more rapidly affected by carbonic oxide than man, and can thus be safely employed for testing, as is now done in mines where the presence of carbonic oxide is suspected.

Experiments made at the Oxford Gas Works with an experimental apparatus.

In accordance with instructions, I have made at the Oxford Gas Works a series of experiments on the working of an apparatus experimentally set up. These experiments have been carried out with the kind co-operation of Mr. James Eldridge, C.E., Engineer to the Oxford Gas Light and Coke Company, and by the courtesy of the Directors of the Company. Mr. Eldridge not only directed the erection of the plant, but a considerable portion of it was lent by him and by the Company. I am also indebted for valuable help and advice to Mr. Dowson, of the Dowson Economic Gas Company, Westminster.

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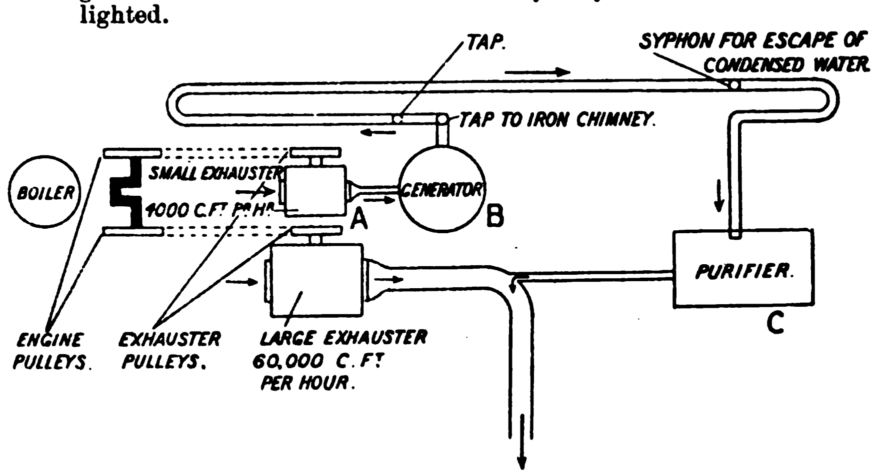
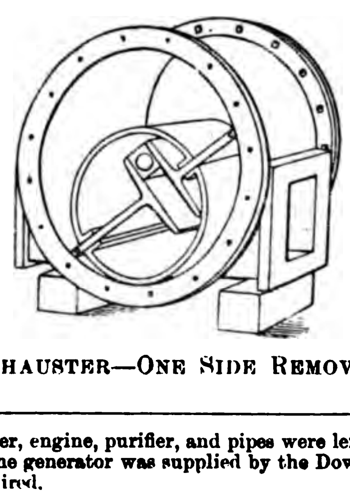
On the use of Carbonic Oxide for Destroying Rats on Plague-Infected Vessels; by Dr. Haldane, F.R.S.

The accompanying diagram shows the general arrangement of the plant.* The air for making the producer gas was driven by means of the small exhauster A. through the incandescent coke in the generator B. The producer gas thus formed was cooled in the 4-inch iron pipe (of which about 40 yards were required) between the generator and the purifier C. The gas then passed from the purifier and mingled with the air of the main air-current as shown. The latter current was produced by the action of the large exhauster, the air being driven along an iron pipe of 8 inches diameter. As the two exhausters were coupled up to the same engine, the desired proportion of gas and air was maintained practically constant in spite of variations in the speed of the engine, and in the resistances to either air current. The gas-generator and connections were kept air-tight. As the gas was smoky any leakage could be seen at once; but there was no difficulty in preventing leakage, provided the doors of the generator were luted in the ordinary way after the fire was lighted.





EXHAUSTER—ONE SIDE REMOVED.

* The large exhauster, engine, purifier, and pipes were lent by the Gas Company and Mr. Eldridge. The generator was supplied by the Dowson Company, and the small exhauster was hired.

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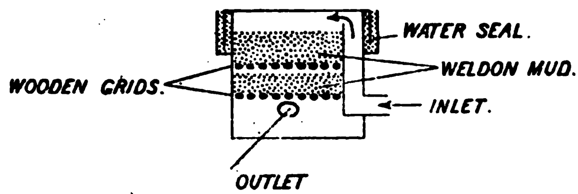
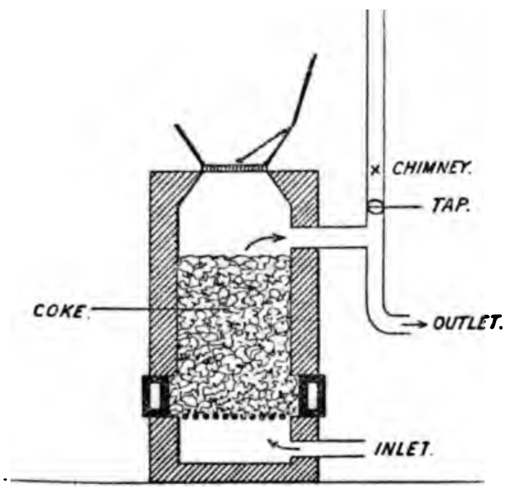


SECTION OF PURIFIER.



SECTION OF GENERATOR.

The generator was re-charged from above at intervals of a few hours. After each charging the smoky gas was allowed to escape from the valve at the top, or from the chimney, until it burned easily when a light was applied. The valve was then closed, and the gas sent forward through the purifier. The fuel employed was coke which had been crushed into fragments of about 1 inch diameter.

The engine used was an old portable steam engine usually employed for grinding mortar and other similar duty about the gas works.

No difficulty was experienced in making 60,000 cubic feet per hour of the required mixture. The quantity made was measured with an ordinary anemometer. In a permanent installation it would be preferable to use two fixed anemometers, indicating manometrically the velocity of the currents of air and gas. The engineer in charge of the apparatus could thus see at a glance how much of the mixture was passing, and whether the proportions were correct.

The plant was on such a scale that a permanent installation could easily be mounted on a barge.

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Composition of the producer gas.

Samples of the crude and purified gas were obtained through holes bored in the pipes entering and leaving the purifier. The crude gas was always smoky, and quickly blackened lead paper held in the stream of gas. The following is a complete analysis of the crude gas passing after the generator had been running without being re-charged for several hours :—

Carbonic oxide	27·61
Hydrogen	4·18
Carbonic acid	3·75
Sulphuretted hydrogen*	0·07
Nitrogen	64·39
	100·00

In other samples taken on various days the percentage of carbonic acid was found to be 4·2 per cent., 5·5 per cent., 3·7 per cent., and 3·1 per cent. It was thus evident that in ordinary working the composition of the producer gas varied slightly according to the temperature of the coke, &c., the percentage of carbonic acid sometimes increasing a little at the expense of the carbonic oxide, or *vice versâ*. The first analysis quoted probably represents very closely the average composition of the gas. The sulphuretted hydrogen was several times determined, but was always below 0·1 per cent. The hydrogen must have come chiefly from the coke, as only about 1 per cent. could be due to the moisture of the air. Hydrocarbons were absent. The gas has a specific gravity about 3·3 per cent. lower than that of air ; and the mixture of gas and air as passed into the hold of a vessel will be about 0·2 per cent. lighter than air, and will thus have no tendency to remain at the bottom of the hold. Actual experiments on ships may show that it is preferable to use a lighter gas, so as to make sure of filling the hold from above downwards in all parts with the poisonous mixture. If such a mixture is required it can be produced by allowing a sufficient proportion of steam to enter the generator along with the air, and thus increasing the percentage of hydrogen in the gas.

Arrangement of the purifier.

The object of the purifier was to remove (1) sulphuretted hydrogen and (2) smoke. In the first experiments moist lime was used as a purifying material, this being spread on wooden

* Determined separately by Harcourt's colorimetric method. Another analysis of the gas soon after re-charging gave—

Carbonic oxide	25·3
Hydrogen	6·1
Carbonic acid and sulphuretted hydrogen ...	5·2
Nitrogen	63·4
	100·0

grids in the ordinary way in a layer about 6 inches deep, with a second set of grids and layer of lime above. The gas was passed up through the lime from below. The lime served its purpose excellently for a short time; but it was found (1) that the resistance offered by the lime soon increased to such an extent that the proper quantity of gas would not go through; (2) that, as could be foreseen, the lime soon became useless for stopping sulphuretted hydrogen, the whole of the latter gas been driven forward by the carbonic acid. As there was no object in absorbing the carbonic acid "Weldon mud"* was substituted for lime. This completely stopped both sulphuretted hydrogen and smoke, and was very slowly used up; but there was the same trouble as before from increase of resistance in the purifier. To ascertain the cause of this increase of resistance the gas was made to travel downwards, instead of upwards, through the purifying material, so that the change produced by the gas in the Weldon mud could be easily seen on removing the cover of the purifier. It was found that the extra resistance had nothing to do with the chemical change in the manganese dioxide, but was simply due to the deposit of particles of smoke in the surface pores of the Weldon mud. The slightest disturbance of the superficial layer, as by lightly passing a piece of wood over the surface, was sufficient to remove entirely all the extra resistance. Thus in one observation it was found that after this operation five times as much gas passed through at the same pressure (about 1½ inches of water).

The purifier employed had only 15 square feet of surface; and although 5,000 cubic feet of gas per hour easily passed through at first, under a pressure of about 2 inches of water, yet after about half-an-hour the pressure required had mounted up very considerably, so that the water-seal of the purifier-lid was sometimes in danger of being broken unless the engine was slowed down. The resistance increased indefinitely if the experiment was continued, so that at last the gas could only be passed at a fraction of its proper rate. The amount of gas actually passing was estimated from anemometer readings of the average velocity of the air-current into the opening of the exhauster, account being taken of the fact that the volume of gas is about one-fifth greater than the volume of air entering the generator.

From the various experiments I came to the conclusion that it would be desirable to have a purifier of about 40 square feet area charged with Weldon mud in two separate tiers of about 6 (upper) and 3 (lower) inches deep, and the gas passing downwards. The cover should be bolted on gas-tight (a water-seal being unsuitable for use on a barge), and the purifier should be provided with two rakes possessing handles passing gas-tight through one side of the purifier, so that the surface of the Weldon mud could be raked over at intervals without disturbing the working

* Weldon mud is extensively used in gas works for stopping sulphuretted hydrogen. It consists of impure manganese dioxide. The reaction occurring is represented by the equation – $MnO_2 + 2H_2S = MnS_2 + 2H_2O$. When air is admitted the sulphide is decomposed, the oxide being re-formed, and sulphur deposited. The Weldon mud is thus "revivified."

of the apparatus. A tube for allowing gas to escape from between the two layers should also be provided; and when sulphuretted hydrogen appears through this tube, as shown by discolouration of lead paper, the purifier should as soon as possible be opened to allow of revivification or replacement of the upper tier. If plugs were provided in the purifier above and below these could be left open when the apparatus was not in use, so as to keep the Weldon mud always in proper condition. The Weldon mud in the purifier would be capable of absorbing, without revivification, the whole of the sulphuretted hydrogen of about 500 hours' make of gas. The actual time over which the purifier could be used without recharging would need to be determined by experiment. During the work of the apparatus at Oxford there was never the slightest trace of escape of sulphuretted hydrogen through the purifier.

The gas which had passed the purifier was transparent and had only the slight garlic-like odour of carbonic oxide itself. Great care was of course necessary not to inhale too much of this gas during testing operations.

The mixture of gas and air.

As regards the mixture of gas and air to be blown into the holds, &c., of a vessel two points have to be borne in mind—(1) The mixture must be capable of killing with certainty any rat or mouse with which it comes in contact; (2) there must be no chance of so much gas being present that the mixture is explosive or inflammable, so that the presence of a light or fire in the ship would cause risk.

To kill a warm-blooded animal with certainty about ·5 per cent. of carbonic oxide must be present in the air. As little as ·2 per cent. will sometimes kill but usually it will only stupefy; ·5 per cent. is needed to produce a fatal effect within a reasonable time. If, however, air containing only ·5 per cent. were used in the hold of a vessel, it seems pretty certain that in many parts the rats would escape, owing to dilution of the mixture with the air originally present; and I think that air containing about 1·5 per cent.* (or 6 per cent. of producer gas) ought to be employed. This kills a rat within about five minutes.

Air containing carbonic oxide does not become inflammable until 13 per cent. of the latter is present. (*See* Clowes' "The Detection of Inflammable Gas in Air," 1896, p. 2.) There is thus an ample margin of safety if the mixture sent in contains only 1·5 per cent. It is conceivable, however, that owing to defects in the apparatus or abnormal resistance to the air-current the proportions might vary. In the first place, the mixture of gas and air in the pipe might be imperfect, the lighter producer gas remaining at the top and the air passing below. To ascertain whether this happened I took

* The arrangement of pulleys and exhausters in the experiments gave a mixture containing nearly 2 per cent. of carbonic oxide.

samples from the top and bottom of the pipe at about 20 feet beyond the point of junction of the streams of producer gas and air.

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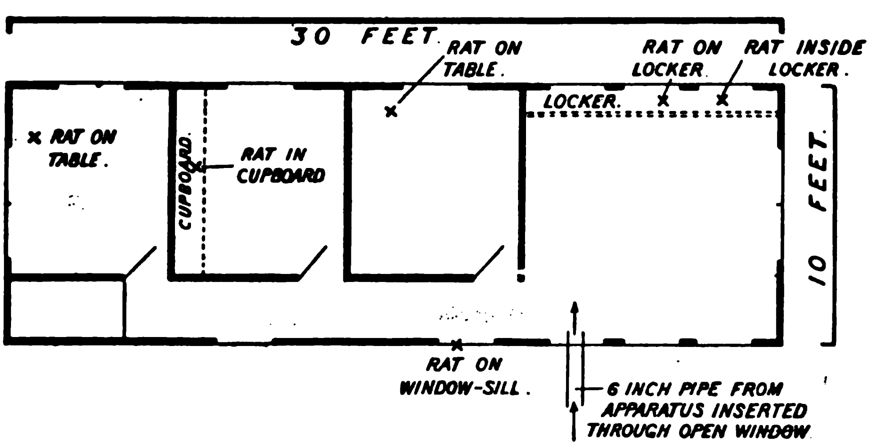
The oxygen percentage was found to be exactly the same (19·30 per cent.) in the two samples, so that the mixture was perfect, there being 7·66 per cent. of producer gas present both above and below. I also partially blocked the outlet with bricks, so as to increase greatly the resistance to the air current. A sample gave 19·18 per cent. of oxygen, so that the percentage of producer gas was only very slightly (·64 per cent.) altered. Increase of resistance in the purifier could only, of course, lead to a diminution (from leakage back through the exhauster) in the percentage of producer gas, and could not, therefore, be a source of danger. In the course of the experiments I could see no danger of the mixture ever becoming inflammable. In order, however, to keep its composition as constant as possible, and for other reasons, I think it would be desirable to provide escape valves both on the current of gas between the generator and purifier, and on the main current beyond the point of mixture of air and gas. These valves should open as soon as the pressure exceeds about 6 inches of water on the producer gas current, and 2 inches on the main current.

Description of an experiment on a house-boat.

With a view to roughly testing, so far as possible ashore, the action of the poisonous gas, the following experiment was made at Oxford.



A house-boat was moored opposite the apparatus, which had been set up on the bank of the river. The arrangement of rooms in the house-boat is shown in the accompanying diagram. The total cubic capacity was about 2,000 feet. The pipe of the apparatus was inserted through an open window, and the rest of the

opening blocked with tarpaulin. Rats in cages were placed at the situations shown in the diagram. All the doors and windows were then closed, with the exception of about an inch of window in each of the three smaller rooms. A current of about 50,000 cubic feet per hour of the poisonous mixture was now blown into the house-boat, and the rats (of which four were visible through the windows) watched.

The rat in the larger room became powerless in three minutes, and was dead in six minutes. The other three visible rats were all dead at the end of nine minutes. At the end of 10 minutes the engine was stopped, so that no more poisonous air entered. Immediately afterwards a sample of the poisonous air was obtained from the large room, and was found to contain 19·58 per cent. of oxygen, which corresponds to 6·5 per cent. of producer gas, or 1·8 per cent. of carbonic oxide. A minute or two later the rats in the locker and cupboard were examined. That in the locker was dead, but the other was still alive and moving, though a few minutes further exposure would doubtless have proved fatal to it. The experiment does not afford any very certain indication that equal success would attend trials on a large vessel, but the result, so far as it went, was quite satisfactory.

These experiments have, I think, shown that it is possible to make, by means of apparatus capable of being mounted on a barge, a mixture of carbonic oxide and air suitable in composition, and sufficient in amount, for the purpose of destroying rats in vessels.

PLATE I.

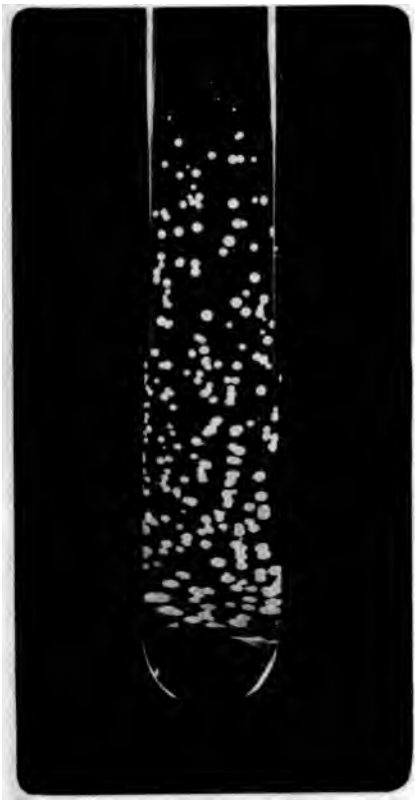


FIG. 1.

FIG. 2.

FIG. 3.

PRESERVED FOOD STUFFS.

PLATE I.

FIG. 1.

Colonies of pathogenic yeast growing on the slanting surface of gelatine, several days' incubation.

[Natural size.]

FIG. 2.

Streak culture of same microbe on gelatine after several days' incubation.

[Natural size.]

FIG. 3.

Colonies of same microbe on the surface of agar in a plate after two days' incubation.

[Magnifying power 14.]

PRESERVED FOOD STUFFS.

PLATE II.

FIG. 4.

Film specimen of contents of tumour at seat of inoculation in a guinea-pig, showing pure culture of typical yeast cells and few cylindrical forms.

[Magnifying power, 500.]

FIG. 5.

Same yeast from recent agar culture, Gram stained.

[Magnifying power, 500.]

FIG. 6.

Film specimen of contents of tumour of testis, developed in a guinea-pig after subcutaneous inoculation in the groin with culture of the yeast; showing numerous typical yeast cells and one cylindrical form.

[Magnifying power, 500.]

FIG. 7.

Section through the ileum of guinea-pig, after intraperitoneal injection with culture of the microbe. In the mucosa (upper part of figure) crowds of yeast cells and a few cylindrical forms, the same in the sub-mucous lymph tissue (lower part of figure).

[Magnifying power, 125.]

PLATE I

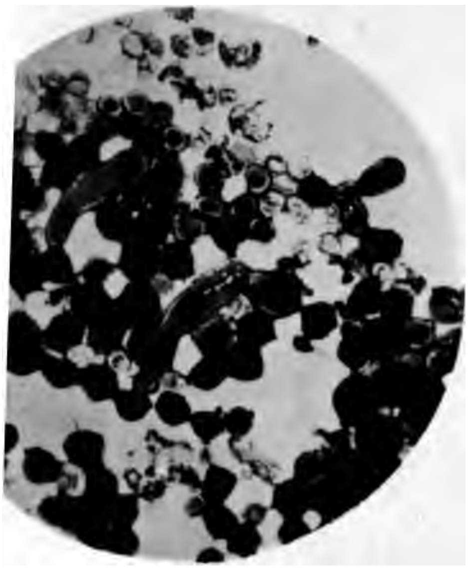


FIG. 4.

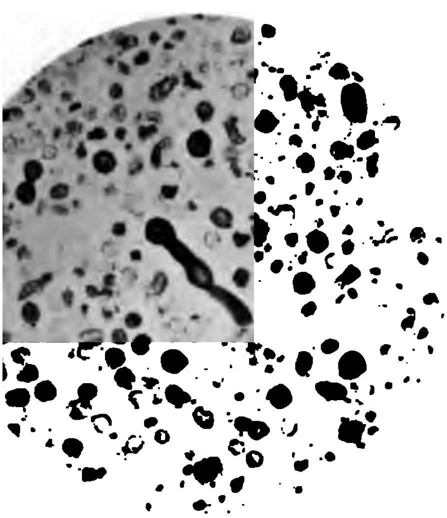


FIG. 6.

a
c

g
c
o

i
p
f
fi

PLATE III.

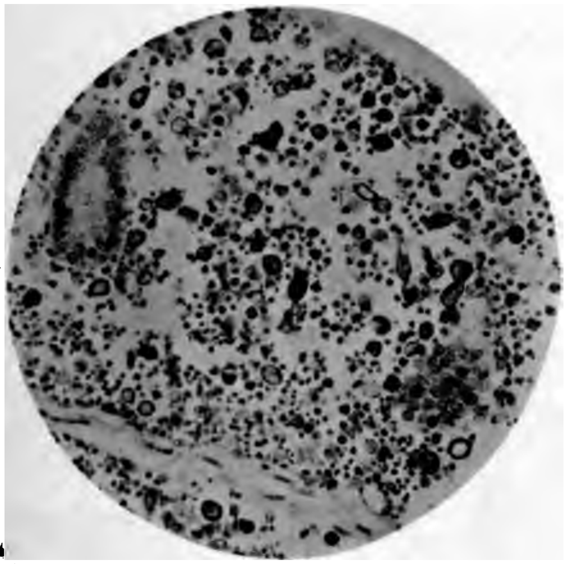


FIG. 8.

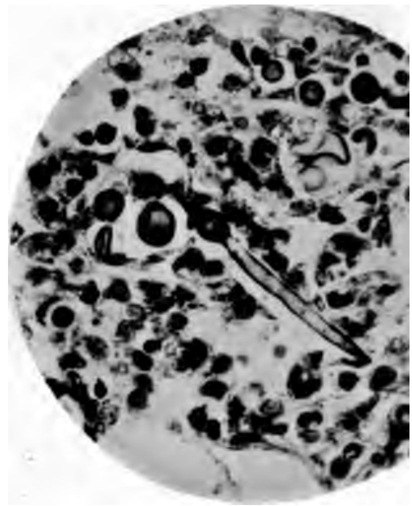


FIG. 9.

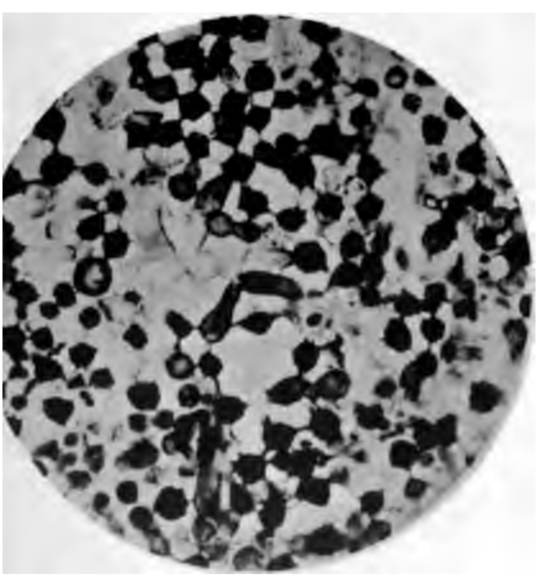


FIG. 10.

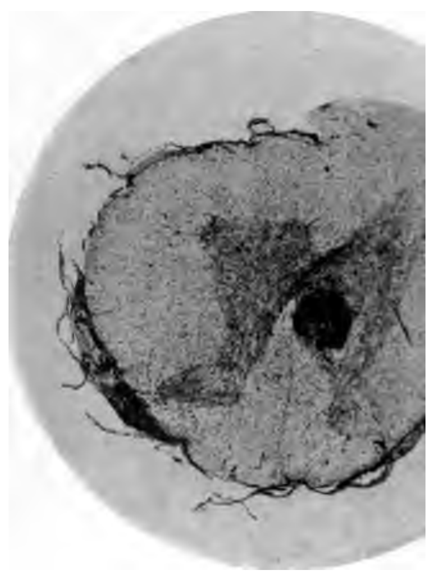


FIG. 11.

PRESERVED FOOD STUFFS.

PLATE III.

FIG. 8.

From the same specimen (mucosa) as in preceding figure, but more highly magnified.

[Magnifying power, 300.]

FIG. 9.

From a section through a nodule of the lung, of a guinea-pig injected subcutaneously in the groin with culture of the yeast. Showing, amongst the cells constituting the tumour, numerous typical yeast, and one cylindrical form.

[Magnifying power, 500.]

FIG. 10.

Film specimen of the contents of a tumour produced in the groin of a guinea-pig after injection of culture of the yeast. The gelatinous interstitial material between the yeast cells (drawn out in the shape of filaments) is well seen; a few cylindrical forms.

[Magnifying power, 500.]

FIG. 11.

Section through the lower dorsal—upper lumbar region of the spinal cord of a rabbit, which some 5—6 weeks previously had been injected intravenously with culture of the yeast. In the region of Clarke's column is a granuloma in the right half of the cord, deranging the anterior grey horn.

[Magnifying power, 12.]

PRESERVED FOOD STUFFS.

PLATE IV.

FIG. 12.

Granuloma of previous figure more highly magnified, showing the tumour to be composed partly of necrotic tissue, partly of masses of round cells; in the centre of the tumour masses of yeast cells.

[Magnifying power, 60.]

FIG. 13.

Centre of the same granuloma as in previous figure, more highly magnified, showing masses of the yeast cells in necrotic tissue.

[Magnifying power, 200.]

FIG. 14.

Section through right spinal ganglion in the region of above granuloma, showing much inflammatory infiltration.

[Magnifying power, 85.]

FIG. 15.

Part of same ganglion as in previous figure, more highly magnified, showing numerous yeast cells.

[Magnifying power, 200.]

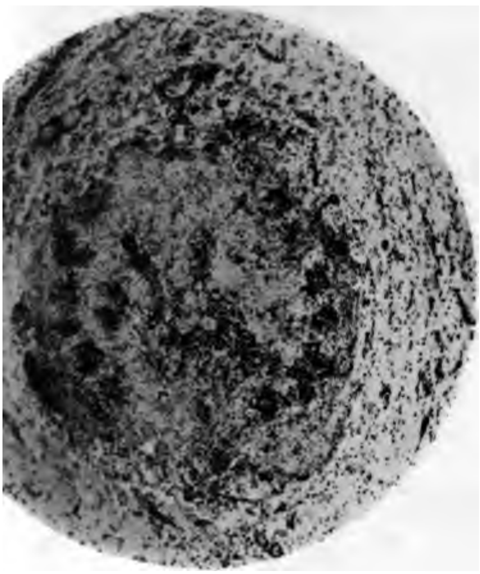


Fig. 12.

Fig. 14.

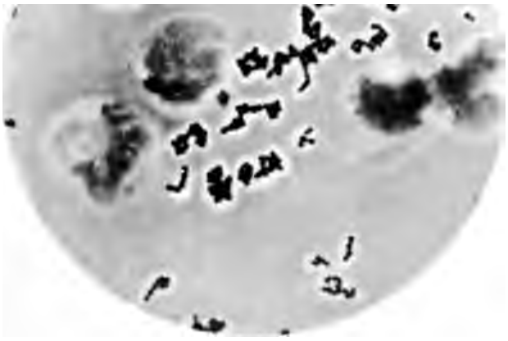


FIG. 16.

FIG. 17.

PRESERVED FOOD STUFFS.

PLATE V.

FIG. 16.

Film specimen of pus of abscess caused in a guinea-pig by injection of culture of streptococcus radiatus, showing numerous clumps of streptococci amongst the pus cells.

[Magnifying power, 1,000.]

FIG. 17.

Conglomerated mass of streptococcus radiatus from broth culture.

[Magnifying power, 1,000.]

FIG. 18.

Colonies of streptococcus radiatus on surface of gelatine, after about a week's growth.

[Magnifying power, 25.]

PRESERVED FOOD STUFFS.

PLATE VI.

FIG. 19.

Film specimen of pus of an abscess in a guinea-pig caused by injection of culture of bacterium diphtherioides showing small and large aggregations of the bacillus.

[Magnifying power, 1,000.]

FIG. 20.

Film specimen from an agar culture of bacterium diphtherioides, stained after Gram.

[Magnifying power, 1,000.]

FIG. 21.

From a culture of slightly attenuated bovine tubercle bacilli; the culture was on glycerine agar and had been growing for about 5 days. The dark bacilli are acid fast tubercle bacilli that have retained the fuchsin, the light bacilli are acid weak tubercle bacilli which have lost the fuchsin colour and taken the (second) blue contrast stain.

[Magnifying power, 1,000.]

PLATE VI.

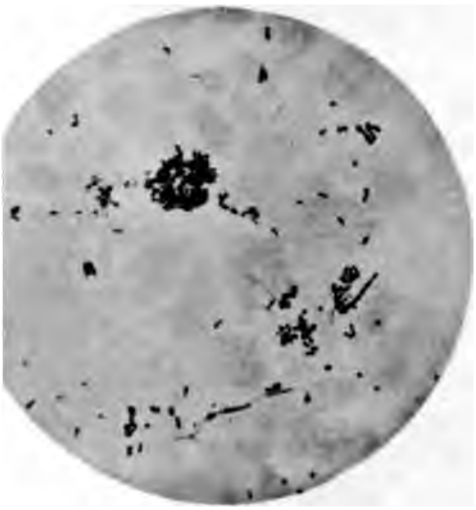


Fig. 19.

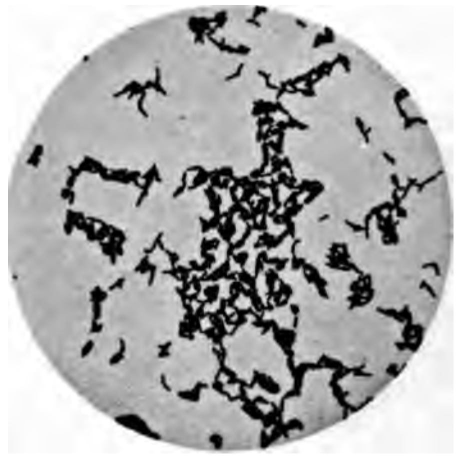


Fig. 20.

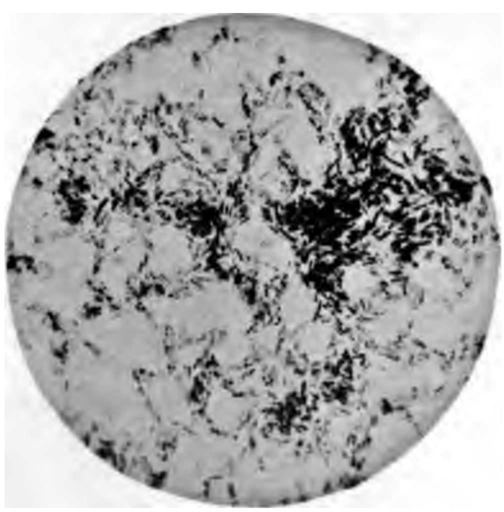


Fig. 21.

PLATE VII.

FIG. 1.

FIG. 2.

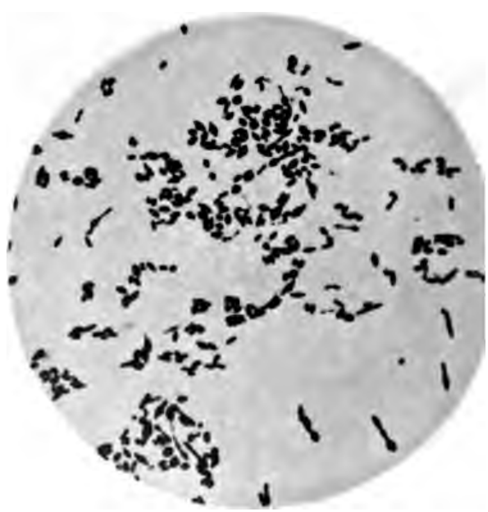


FIG. 3.

STREPTOCOCCUS SCARLATINÆ.

PLATE VII.

FIG. 1.

Microscopical preparation made from a colony of S. scarlatinæ of 18 hours' growth on serum at 37° C. The serum was inoculated with $\frac{1}{50,000}$ cc. of the tonsillar secretion of case III. on the 4th day of scarlatina. The coherency of the growth is here seen.

[Magnifying power, 18.]

FIG. 2.

Part of the same preparation under a high power. Some of the individuals show a spindle, some a bacillary tendency.

[Magnifying power, 1,000.]

FIG. 3.

Preparation made from a colony of scarlatinæ of 48 hours' growth on serum at 37° C. The serum had been inoculated with $\frac{1}{300,000}$ cc. of the tonsillar secretion of Case V. on the 5th day of scarlatina. Spindle-shaped forms are here particularly well seen.

[Magnifying power, 1,000.]

STREPTOCOCCUS SCARLATINÆ.

PLATE VIII.

FIG. 4.

Impression-preparation of a colony of S. scarlatinæ on gelatine on the 5th day. Bacillary forms are here particularly well developed.

[Magnifying power, 1,000.]

FIG. 5.

Impression-preparation of a colony of S. scarlatinæ on gelatine on the 14th day. The organism was isolated from the tonsillar secretion of a case on the 8th day of scarlatina. Spindle and bacillary forms are seen among the cocci.

[Magnifying power, 1,000.]

FIG. 6.

Impression-preparation of a colony of S. pyogenes, isolated from the same case, and kept under the same conditions. No spindles or bacillary forms are here seen.

[Magnifying power, 1,000.]

PLATE VIII.

FIG. 4.

FIG. 5.

FIG. 6.

PLATE IX.

FIG. 7.

FIG. 8.

FIG. 9.

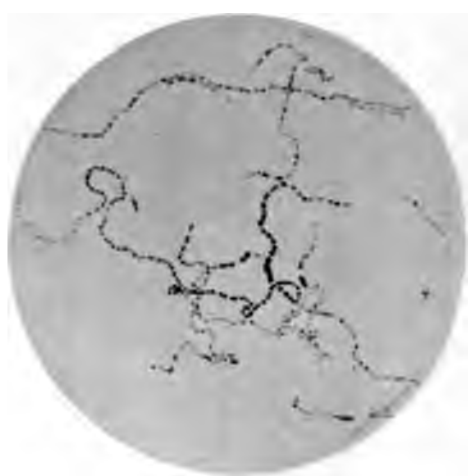


FIG. 10.

STREPTOCOCCUS SCARLATINÆ.

PLATE IX.

S. SCARLATINÆ *v.* B. DIPHTHERIÆ.

FIG. 7.

Microscopical preparation of the growth on serum in 1 day at 37° C. of the laboratory culture of B. diphtheriæ. Stain, methylene blue.

[Magnifying power, 1,000.]

FIG. 8.

The growth under the same circumstances of an example of S. scarlatinæ isolated from $\frac{1}{300,000}$ cc. of the tonsillar secretion of Case VII. The resemblance of some of the bacillary forms to those in Fig. 7, is obvious.

[Magnifying power, 1,000.]

FIG. 9.

Sub-culture in broth, 1 day, 37° C., from the culture seen in Fig. 7. Small clumps of diphtheria bacilli are seen.

[Magnifying power, 1,000.]

FIG. 10.

Similar sub-culture from the culture seen in Fig. 8. The streptococcus phase of S. scarlatinæ has been brought out by the fluid medium.

[Magnifying power, 1,000.]

STREPTOCOCCUS SCARLATINÆ.

PLATE X.

S. SCARLATINÆ *v.* S. PYOGENES.

FIG. 11.

S. pyogenes isolated from $\frac{1}{250,000}$ cc. of the tonsillar secretion of Case I. on the second day of scarlatina. Growth in broth, 1 day, at 37° C. The individuals composing the chains are round cocci.

[Magnifying power in this, and all other figures in this plate, 1,000.]

FIG. 12.

S. scarlatinæ isolated from same culture, and kept under the same circumstances. Some of the individuals show a slightly bacillary tendency.

FIG. 13.

Serum growth, 1 day, 37° C., of S. pyogenes shown in Fig. 11. The individuals are coccus entirely.

FIG. 14.

Similar growth of S. scarlatinæ shown in Fig. 12. Compare the bacillary tendency here seen with the last Fig.

FIG. 15.

Agar growth, 1 day, 37° C., of S. pyogenes shown in Figs. 11 and 13. Here again coccus forms are the rule.

FIG. 16.

Similar growth of S. scarlatinæ shown in Figs 12 and 14. The bacillary tendency is here again seen.

FIG. 17.

Gelatine colony, 14th day, of the S. pyogenes shown in Figs. 11, 13, and 15. The individuals are coccus entirely.

FIG. 18.

Similar colony of the S. scarlatinæ shown in Figs. 12, 14, and 16. Some spindle and bacillary forms are seen.

PLATE X.

Fig. 11.

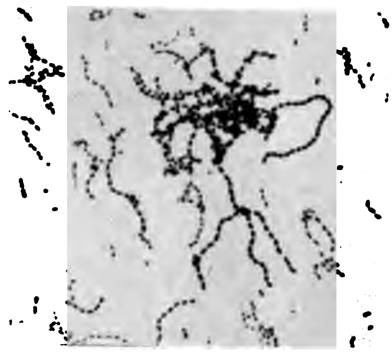


Fig. 12.

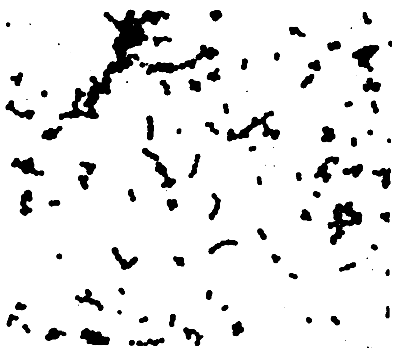


Fig. 13.

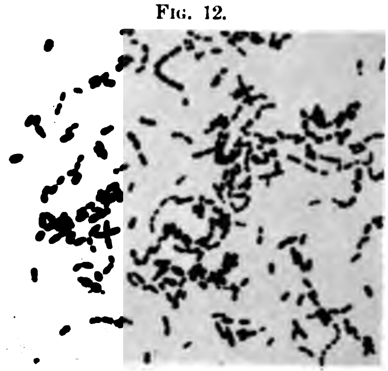


Fig. 14.

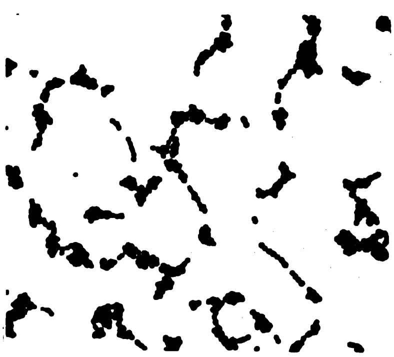


Fig. 15.

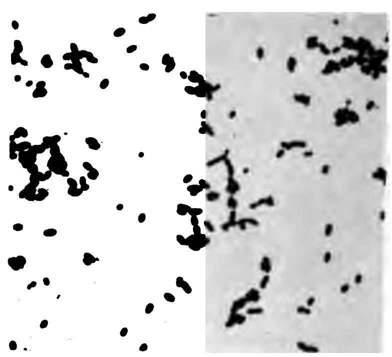


Fig. 16.

Fig. 17.

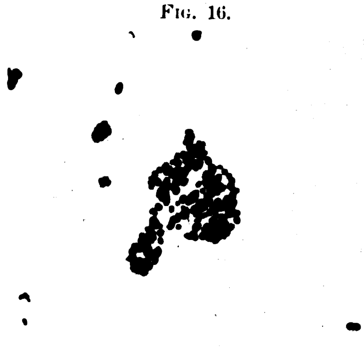


Fig. 18.

PLATE XI.

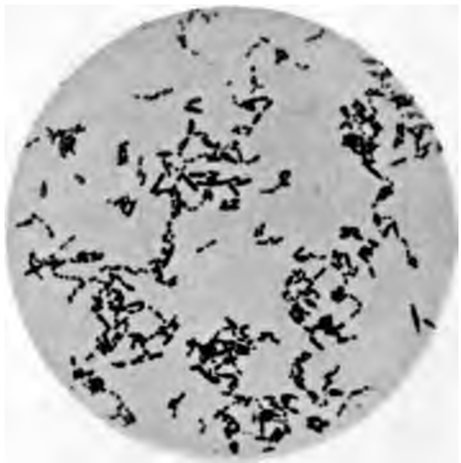


FIG. 19.

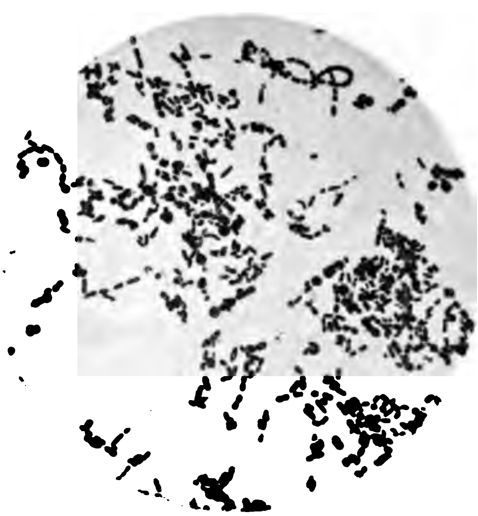


FIG. 20.

FIG. 21.

STREPTOCOCCUS SCARLATINÆ.

PLATE XI.

FIG. 19.

The S. scarlatinæ shown in last plate, on recovery from spleen of mouse. Serum growth, 1 day, 37° C. Bacillary forms are seen as before. Compare Fig. 14.

[Magnifying power, 1,000.]

FIG. 20.

The same organism, on recovery from a further mouse. Serum growth, 1 day, 37° C. Bacillary forms are seen as before. Compare Figs. 14 and 19.

[Magnifying power, 1,000.]

FIG. 21.

The same organism. Broth, 1 day, 37° C. The streptococcus phase is brought out by the fluid medium.

[Magnifying power, 1,000.]

STREPTOCOCCUS SCARLATINÆ.

PLATE XII.

FIG. 22.

Streptococcus No. 2 from scarlatina Case IV. on the 4th day of the disease. Crush-preparation of growth on serum, 1 day, 37° C., showing conglomeration and spindle and bacillary forms.

[Magnifying power, 1,000.]

FIG. 23.

The same organism in the tissues of a mouse. Pus from site of inoculation. The organism occurs in the form of diplococci and short chains and shows a tendency to conglomeration. The individuals are coccus entirely.

[Magnifying power, 1,000.]

FIG. 24.

The same organism. Serum growth, 1 day, on recovery from mouse, now indistinguishable from S. pyogenes.

[Magnifying power, 1,000.]

FIG. 25.

Streptococcus No. 1 (S. scarlatinæ) from same case. Serum growth, 1 day, on recovery from heart's blood of third mouse. Bacillary forms and conglomeration are as clear as in the first place.

[Magnifying power, 1,000.]

PLATE XII.

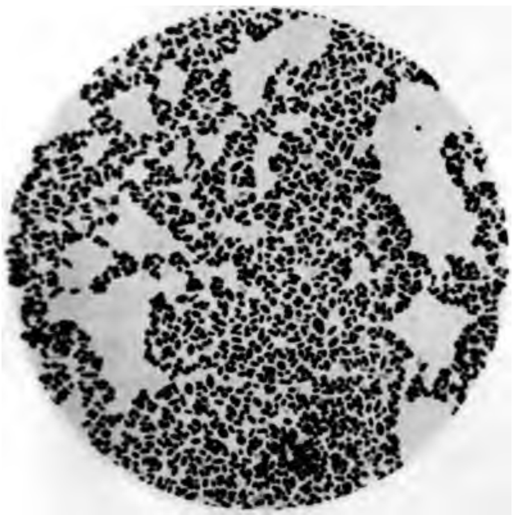


FIG. 22.

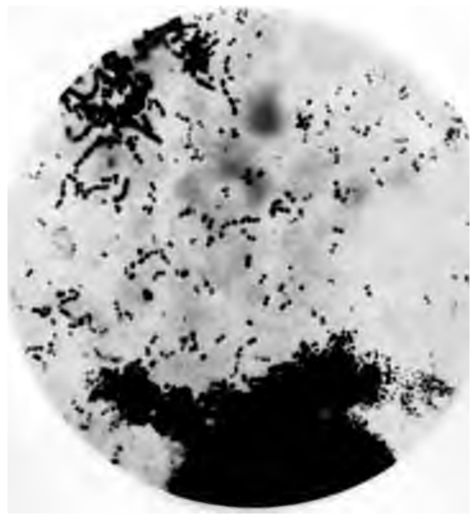


FIG. 23.

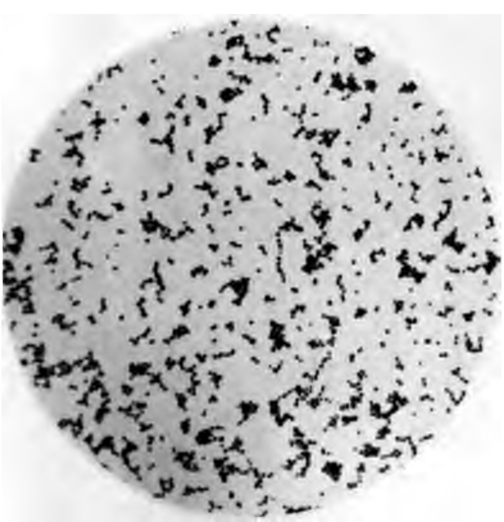


FIG. 24.

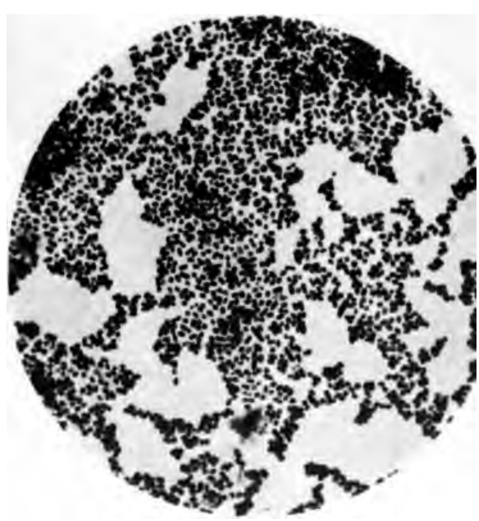


FIG. 25.

PLATE XIII.

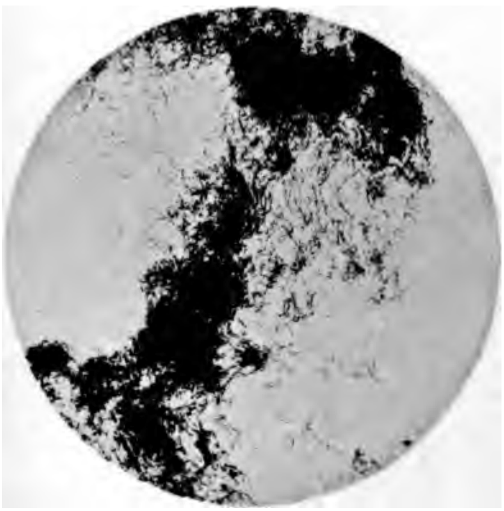


FIG. 26.

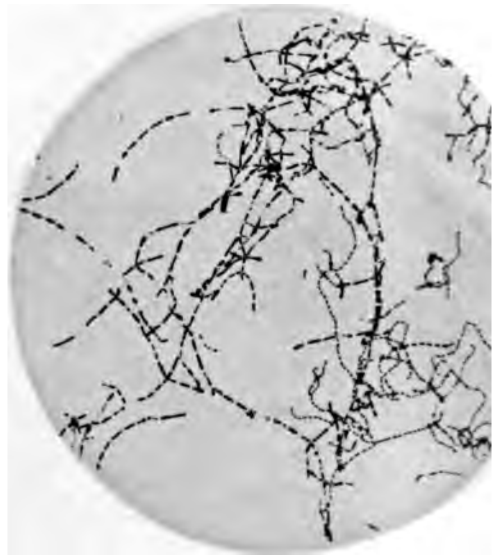


FIG. 27.

FIG. 28.

FIG. 29.

STREPTOCOCCUS SCARLATINÆ.

PLATE XIII.

FIG. 26.

S. scarlatinæ of Case VI., as recovered from lymphatic gland of a guinea-pig that succumbed on the 7th day and gave no growth from its blood and organs. Sub-culture in serum condensation fluid, 1 day, 37° C., from a single colony. Conglomeration is seen and also chain-work.

[Magnifying power, 80.]

FIG. 27.

Part of same preparation under higher power, showing chains composed of coccus forms (few) and bacillary forms (many).

[Magnifying power, 500.]

FIG. 28.

Part of Fig 27 under still higher power. Bacillary forms, some with swollen ends are here well seen.

[Magnifying power, 1,000.]

FIG. 29.

S. pyogenes under the same circumstances, viz., serum condensation fluid, 1 day, 37° C. This organism was isolated from $\frac{1}{100,000}$ cc. of the tonsillar secretion of scarlatina, Case IV. The chains are seen to be composed of round or slightly flattened cocci. The contrast with Fig. 28 is obvious.

[Magnifying power, 1,000.]

STREPTOCOCCUS SCARLATINÆ.

PLATE XIV.

FIG. 30.

Streptococcus, isolated from $\frac{1}{100,000}$ cc. of the tonsillar secretion of diptheria, Case VI., in which the tonsil was sloughing, and no diphtheria bacillus was isolated. The organism in broth, 1 day, 37° C., on recovery from a mouse that succumbed in 1 day. Streptococcus chains are here seen.

FIG. 31.

Growth of the same organism, serum, 1 day, 37° C. Bacillary forms are well marked.

FIG 32.

Section of the spleen of a case (R.C.L.) of pneumonic plague, stained by Gram's method. The plague bacillus, which is in the majority in most parts of the spleen, has been decolourised, and does not show in the photograph. Three groups of streptococci that have retained the stain are here seen lying in the splenic tissue.

PLATE XIV.

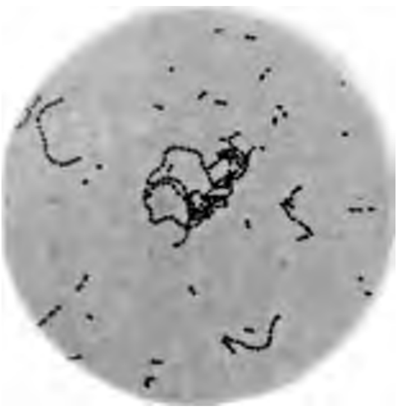


FIG. 30.

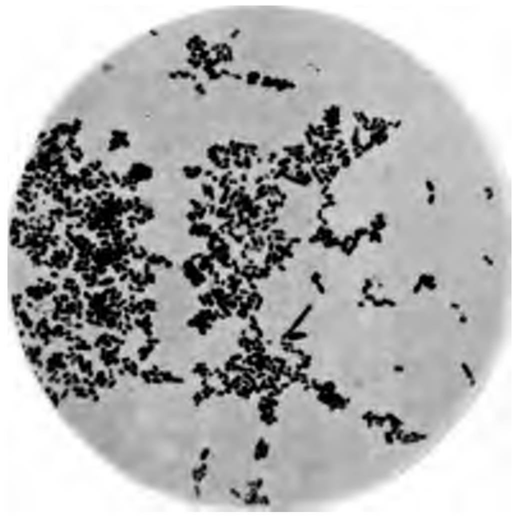


FIG. 31.

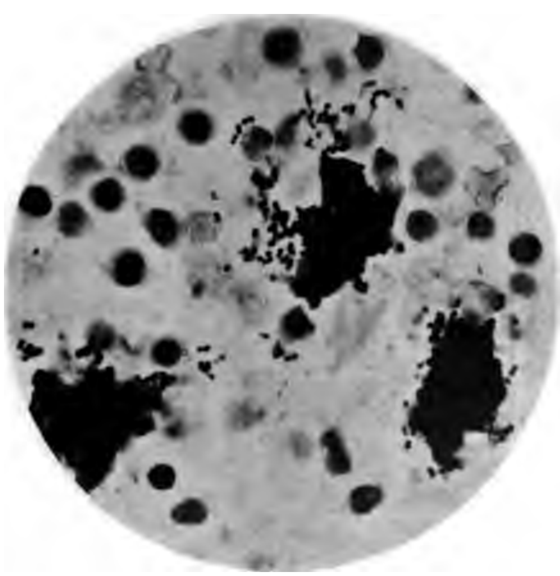


FIG. 32.

PLATE XV.

I. II.

FIG. 33.

I. II.

FIG. 34.

I. II. III. IV.

FIG. 35.

STREPTOCOCCUS SCARLATINÆ.

PLATE XV.

FIG. 33.

Streptococcus pyogenes and streptococcus scarlatinæ isolated from $\frac{1}{100,000}$ cc. of the tonsillar secretion of Case IV., on the 4th day of scarlatina. Both gelatine cultures are 20 days old. The growth of S. pyogenes (tube I.) is smoother, more profuse, and more continuous than that of S. scarlatinæ (tube II).

FIG. 34.

Streptococcus pyogenes and an instance of a streptococcus from the scarlatinæ cadaver immediately indentifiable with S. scarlatinæ. Both gelatine cultures are 4 days old. Tube I., S. pygones, isolated from the throat of a case of diphtheria shows more profuse, and thicker growth that tube II., which is a culture of S. scarlatinæ from the kidney of scarlatinal cadaver No. IV.

FIG. 35.

4 gelatine cultures, all 14 days old. Tube I., the streptococcus, isolated from cervical gland of scarlatinal cadaver No. II. Tube II., S. pyogenes, from spleen of a case of pneumonic plague (R.C.L.). Tube III., S. pyogenes, from heart's blood of a case of septicæmia originating from disease of the larynx. Tube IV., streptococcus, from cervical gland of scarlatinal cadaver No. V. The appearance of the growth is practically the same in all four cases.

BACTERIA IN SOIL, SEWAGE, AND SEWAGE CONTAMINATED SOIL.

PLATE XVI.

FIG. 1.

Gelatine plate culture for spores, $\frac{1}{10,000}$ gramme Hackbridge soil H. (heated to 80° C. for 10 minutes.) In illustration of the enormous number of B. mycoides in soil present in the form of spores. [Part I.—Series 2.]

[About natural size.]

PLATE XVI.

FIG. 1.

PLATE XVII.

FIG. 2.

FIG. 3.

BACTERIA IN SOIL, SEWAGE, AND SEWAGE CONTAMINATED SOIL.

PLATE XVII.

FIG. 2.

Gelatine "impression" preparation of the granular bacillus of soil (24 hours at 20° C.); stained with methylene-blue. Isolated from Hackbridge soil C. [Part I.—Series 2.]

[Magnifying power, 40.]

FIG. 3.

Same as Fig. 2, but a higher magnification.

[Magnifying power, 1,000.]

BACTERIA IN SOIL, SEWAGE, AND SEWAGE CONTAMINATED SOIL.

PLATE XVIII.

FIG. 4.

Microscopic preparation from a broth culture of streptococcus A (cesspool sewage); stained by Gram's method. [Part I.—Series 1.]

[Magnifying power, 1,000.]

FIG. 5.

Microscopic preparation from a broth culture of streptococcus B (cesspool sewage); stained by Gram's method. [Part I.—Series 1.]

[Magnifying power, 1,000.]

FIG. 6.

Microscopic preparation from a broth culture of streptococcus I. (sewage contaminated soil); stained by Gram's method. [Part I. —Series 1.]

[Magnifying power, 1,000.]

FIG. 7.

Microscopic preparation from a broth culture of streptococcus VII. (sewage contaminated soil); stained by Gram's method. [Part I.—Series 2.]

[Magnifying power, 500.]

PLATE XVIII.

FIG. 4.

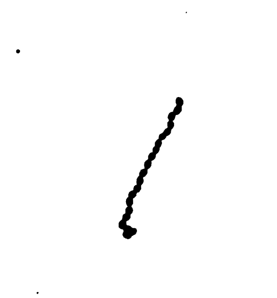


FIG. 5.

FIG. 6.

FIG. 7.

PLATE XIX.

FIG. 8.

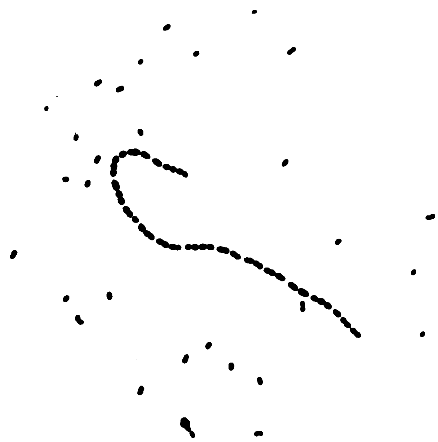


FIG. 9.

FIG. 10.

FIG. 11.

BACTERIA IN SOIL, SEWAGE, AND SEWAGE CONTAMINATED SOIL.

PLATE XIX.

FIG. 8.

Same preparation as Fig. 7, but a higher magnification.

[Magnifying power, 750.]

FIG. 9.

Microscopic preparation from a broth culture of streptococcus A (sewage contaminated soil); stained with weak carbol fuchsin. [Part I.—Series 3.]

[Magnifying power, 1,000.]

FIG. 10.

Microscopic preparation from a broth culture of streptococcus B (sewage contaminated soil); stained with weak carbol fuchsin. [Part I.—Series 3.]

[Magnifying power, 1,000.]

FIG. 11.

Microscopic preparation from a broth culture of streptococcus C (sewage contaminated soil); stained with weak carbol fuchsin. [Part I.—Series 3.]

[Magnifying power, 1,000.]

BACTERIA IN SOIL, SEWAGE, AND SEWAGE CONTAMINATED SOIL.

PLATE XX.

Fig. 12.

Microscopic preparation from a broth culture of streptococcus (1) (sewage contaminated soil); stained by Gram's method. [Part II.—Series A.]

[Magnifying power, 1,000.]

Fig. 13.

Microscopic preparation from a broth culture of streptococcus (2) (sewage contaminated soil); stained with weak carbol fuchsin. [Part II.—Series A.]

[Magnifying power, 500.]

Fig. 14.

Same as Fig. 13, but a higher magnification.

[Magnifying power, 1,000.]

Fig. 15.

Microscopic preparation from a broth culture of streptococcus (3) (sewage contaminated soil); stained with weak carbol fuchsin. [Part II.—Series A.]

[Magnifying power, 1,000.]

PLATE XX.

Fig. 12.

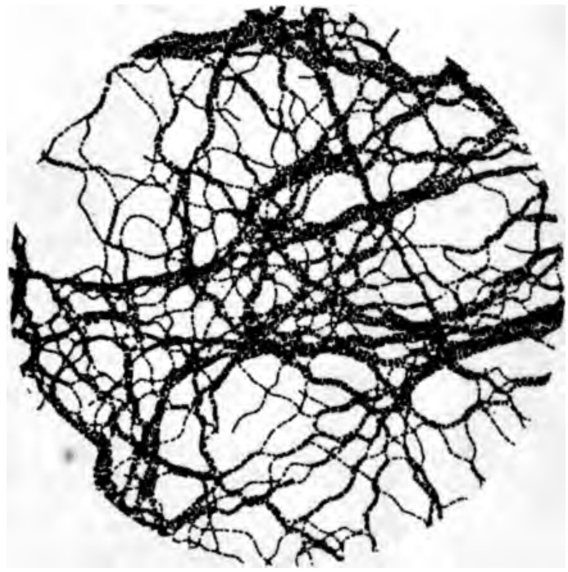


Fig. 13.

Fig. 14.

Fig. 15.

PLATE XXI.

FIG. 16.

FIG. 17.

FIG. 18.

BACTERIA IN SOIL, SEWAGE, AND SEWAGE CONTAMINATED SOIL.

PLATE XXI.

FIG. 16.

Microscopic preparation from a broth culture of streptococcus (4) (sewage contaminated soil); stained with carbol fuchsin. [Part II.—Series A.]

[Magnifying power, 1,000.]

FIG. 17.

Microscopic preparation from a broth culture of streptococcus (6) (sewage contaminated soil); stained with weak carbol fuchsin. [Part II.—Series A.]

[Magnifying power, 1,000.]

FIG. 18.

Microscopic preparation from a broth culture of streptococcus (7) (sewage contaminated soil); stained with weak carbol fuchsin. [Part II.—Series A.]

[Magnifying power, 1,000.]

BACTERIA IN SOIL, SEWAGE, AND SEWAGE CONTAMINATED SOIL.

PLATE XXII.

FIG. 19.

Microscopic preparation from a broth culture of streptococcus (8) (sewage contaminated soil); stained with weak carbol fuchsin. [Part II.—Series A.]

[Magnifying power, 500.]

FIG. 20.

Same as Fig. 19, but a higher magnification.

[Magnifying power, 1,000.]

PLATE XXII.

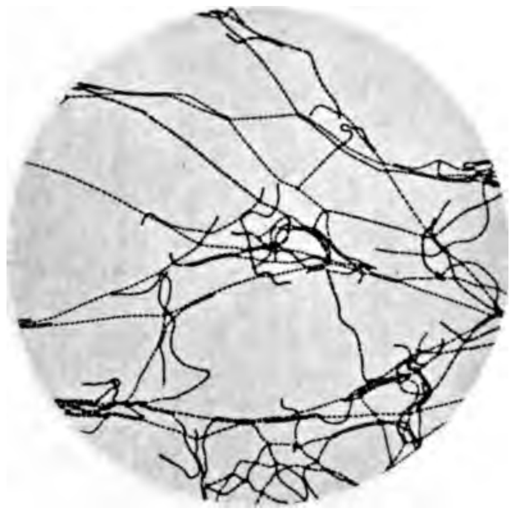


Fig. 19.

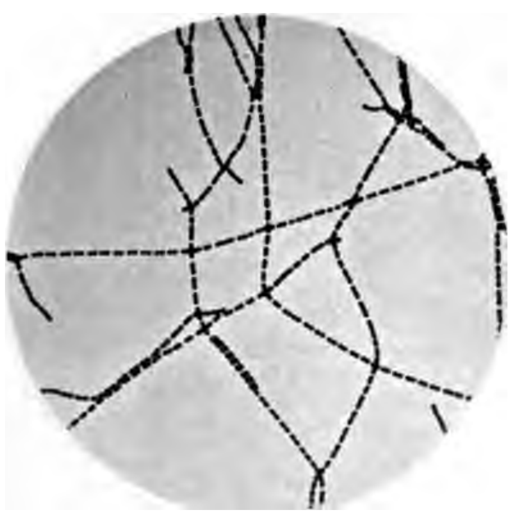


Fig. 20.

PLATE XXIII.

FIG. 2.

FIG. 1.

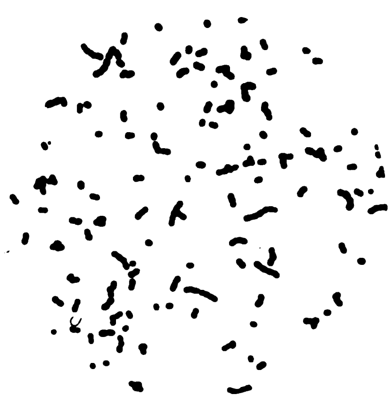


FIG. 3.

FIG. 4.

CHICHESTER WATERS.

PLATE XXIII.

FIG. 1.

Microscopic preparation from a broth culture (48 hours at 37° C.) of water streptococcus (1); sample B^1; stained by Gram's method.

[Magnifying power, 1,000.]

FIG. 2.

Microscopic preparation from a broth culture (48 hours at 37° C.) of water streptococcus (2); sample B^1; stained by Gram's method.

[Magnifying power, 1,000.]

FIG. 3.

Microscopic preparation from an Agar culture (24 hours at 37° C.) of water streptococcus (2); sample A^1; stained by Gram's method.

[Magnifying power, 1,000.]

FIG. 4.

Microscopic preparation from a broth culture (2 days at 20° C. of water streptococcus (3); sample A^1; stained by Gram's method

[Magnifying power, 500.]

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PLATE XXIV.

FIG. 5.

Microscopic preparation from an Agar culture (24 hours at 37° C.) of water streptococcus (4); sample 1^1; stained by Gram's method.

[Magnifying power, 1,000.]

FIG. 6.

Microscopic preparation from an Agar culture (24 hours at 37° C.) of water streptococcus (5); sample 1^1; stained by Gram's method.

[Magnifying power, 1,000.]

FIG. 7.

Microscopic preparation from an Agar culture (24 hours at 37° C.) of water [Microbe 6]; sample J^1; stained by Gram's method. It was not found possible satisfactorily to identify this microbe with the streptococcus class of micro-organism.

[Magnifying power, 500.]

FIG. 8.

Microscopic preparation from a broth culture (24 hours at 37° C.) of water streptococcus (7); sample M^1; stained by Gram's method.

[Magnifying power, 500.]

PLATE XXIV.

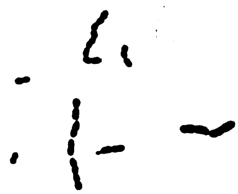

FIG. 5.

FIG. 6.

FIG. 7.

FIG. 8.

Fig. 9.

Fig. 10.

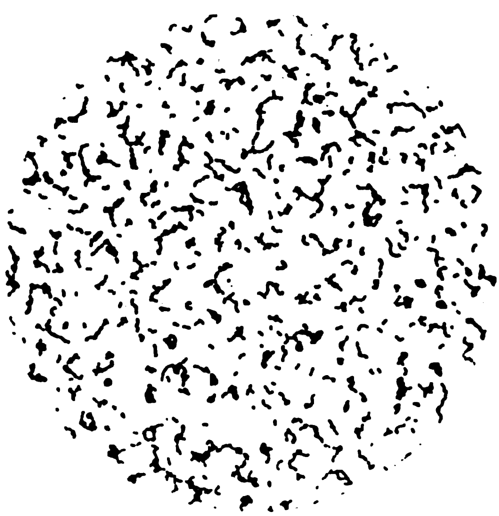

Fig. 12.

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PLATE XXV.

FIG. 9.

Same preparation as Fig. 8, but a higher magnification ; water streptococcus 7.

[Magnifying power, 1,000.]

FIG. 10.

Microscopic preparation from a broth culture (24 hours at 37° C.) of water streptococcus (8) ; sample M^1 ; stained by Gram's method.

[Magnifying power, 1,000.]

FIG. 11.

Microscopic preparation from a broth culture (48 hours at 37° C.) of water streptococcus (9) ; sample 1^2 ; stained by Gram's method.

[Magnifying power, 500.]

FIG. 12.

Same preparation as Fig. 11, but a higher magnification ; water streptococcus (9).

[Magnifying power, 1,000.]

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PLATE XXVI.

FIG. 13.

Gelatine "shake" culture (24 hours at 20° C.) of sample E[1]. The left tube contains 1 cc., the middle tube 10 cc. (bacterial contents of), and the right tube 100 cc. (bacterial contents of). The result is negative as regards "gas" formation in all three. The figure is of interest from the negative point of view. It shows that some waters may yield a negative result with 100 cc. (Pasteur "filter brushing" method). Yet crude sewage almost invariably gives a positive result with 0·001 cc.

[About natural size.]

FIG. 14.

Gelatine "shake" cultures (24 hours at 20° C.) of sample 1[2]. The left tube contains 10 cc. (bacterial contents of), and the right tube 100 cc. (bacterial contents of). Here the result is positive in both cases.

[About natural size.]

PLATE XXVI.

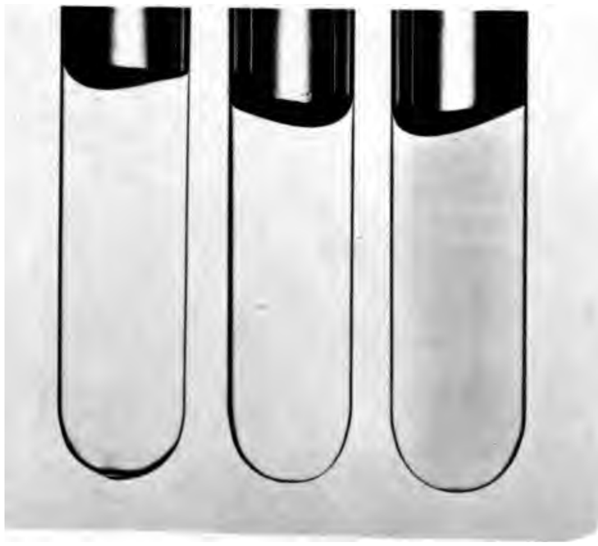


FIG. 13.

FIG. 14.

PLATE XXVII.

FIG. 15.

CHICHESTER WATERS.

PLATE XXVII.

FIG. 15.

Anaërobic milk cultures as for B. enteritidis sporogenes. The left tube contains 10 cc. (bacterial contents of), the middle tube 100 cc. (bacterial contents of), and the right tube 200 cc. (bacterial contents of) of sample F[1]. The tubes were heated to 80° C. for 10 minutes, and cultivated under anaërobic conditions at a temperature of 37° C. for 2 days. Yet the results were quite negative as regards B. enteritidis sporogenes. The figure is of interest from the negative point of view. It shows that B. enteritidis sporogenes may be absent from 200 cc. of some waters. Yet crude sewage almost invariably yields a positive result with $\frac{1}{100}$ to $\frac{1}{1,000}$ cc.

[Slightly reduced.]

MUSSELS AND COCKLES.

PLATE XXVIII.

FIG. 1.

Phenol Agar plate, of which the surface had been infected with a trace of the intestinal contents of a cockle, some days previously removed from typhoid infected sea water, and washed in clean sea water. The colonies here shown are all those of the typhoid bacilli.

[Natural size.]

FIG. 2.

A similar plate of another similar cockle. The colonies are all of the same kind, viz., those of the typhoid bacillus. From this it appears that the typhoid bacillus of the infected sea water had not only entered the alimentary canal of the animal, but had actually multiplied therein.

[Natural size.]

PLATE XXVIII.

FIG. 1.

FIG. 2.

APPENDIX C.

Reports on Research Work in connection with Glycerinated Calf Lymph.

Introduction; By Dr. F. R. Blaxall.

The study of vaccine as obtained from the calf, and of the changes which take place in it during the process of glycerination and in the period of storage prior to its issue, presents a large and complex field for investigation; and it is from knowledge derived from such investigation that we can alone expect to ensure the attainment of a vaccine pure in itself and certain in action. The empiricism of the older method of vaccination, to a large extent, left unexplored the principles which underlie the production of a vaccine possessing the most desirable properties and retaining none but these properties. So many are the conditions that go to the securing of such a vaccine, and so complex are the biological phenomena of its origin—liable as they are at any moment to undergo change through slight variation in atmospheric conditions, light, humidity of temperature or altered nutrition—that there is needed most patient and painstaking research to arrive at a definite exposition of even the most simple of these principles. Accordingly we have confined our investigations in the first place to the simpler subjects, especially to those most directly concerned with the results of glycerination. In this sense the aim of our work has been twofold. In the first place, to follow up the study of the bacteriological flora associated with calf lymph in as complete a way as possible; and secondly, to ascertain the limitations of the specific virus of vaccine apart from and in conjunction with glycerine under various influences, parallel study being meanwhile carried on as to the limitations of the extraneous organisms. This scheme of work, devised in consultation with my colleagues Mr. H. S. Fremlin and Dr. A. B. Green, has been divided and carried out between us under conditions of reciprocal assistance. The greater part of the actual work has been performed by Mr. Fremlin and Dr. Green; of that which appears under my name I wish to express my indebtedness to them for continuing it when I have been prevented from carrying it on in its proper sequence.

The Bacteriological Flora of Lymph.

In continuation of the work on the "Bacteriological Flora" of glycerinated calf lymph, on the ordinary aërobic culture of which Mr. Fremlin contributed a paper last year, Dr. Green has in the regular routine of laboratory work examined 530 samples of lymph in the same way as before, not only in regard to enumeration of organisms contained in the lymphs, but also with a view to

the isolation and identification of the several species. Dr. Green's observations corroborate Mr. Fremlin's in every respect. He finds that there is practically but little variation in the numbers of organisms present in the lymphs as we collect them, and that the species correspond almost exactly with those already described in regard to both frequency of occurrence and predominance. No organism was found in the lymphs differing from those described in Mr. Fremlin's report. These observations are based on the examination of some 4,770 plate cultures.

This subject of the bacteriological flora of lymphs and the cultural properties of the micro-organisms has, however, been pursued further. For though previous experience had led me to believe that the examination of glycerinated calf lymph by means of cultures on ordinary agar plates afforded the best and most accurate method of sorting out the contained extraneous organisms, it was considered desirable to investigate the subject more fully so as to ascertain whether other methods of procedure might not disclose the occasional or constant presence of micro-organisms hitherto undescribed. Special interest attached to this quest in view of statements which appeared in the "Report of *The Lancet* Special Commission on Glycerinated Calf Vaccine Lymphs." * In the examinations there detailed, agar and gelatine in plates, and glucose agar in tubes were the culture media used. The agar plates were incubated at blood heat and the gelatine plates at 20° C. to 21° C.; and it seems to have been the experience of the Commissioners that more micro-organisms grew upon the agar than on the gelatine media. In this connection they made the remark that "the results obtained with the agar plates are looked upon as the more important, because most of the irritant and parasitic micro-organisms grow more readily at the temperature of the body than they do at the temperature of the room." In his experiments however with gelatine Mr. Fremlin shows that the extraneous organisms present in glycerinated calf lymph develop as well at room temperature as at body temperature, and as well or even better on gelatine as on agar. Again in *The Lancet* Report it is definitely stated that glucose agar tubes were inoculated and kept at body temperature (whether as "shake" cultures or "rolled" tubes is not explained), and it is affirmed that "the glucose agar results are of importance, because they bring into prominence the anaërobic organisms which do not make their appearance either on agar or gelatine plates"; and again there is the statement that "of these spore-bearing organisms a certain proportion are anaërobic, and can only be grown under anaërobic conditions, as, for example, in glucose agar tubes," indeed throughout *The Lancet* Report organisms are called anaërobic if they made their appearance in glucose agar tubes. The use of the term "anaërobic" in this way is altogether without sufficient warrant. Growth in glucose agar does not necessarily mean anaërobiosis. It is true that strictly anaërobic organisms will grow in glucose agar stabs, as for instance B. tetani; but the anaërobic properties of B. tetani are shown by the fact that it will not grow aërobically; nevertheless not a particle of evidence is

* *The Lancet*, April 28th, 1900.

given throughout *The Lancet* Report to show that an organism found capable of growth in a glucose agar tube was not equally capable of growth under aërobic conditions. Until such evidence is supplied it is not possible to accept the organisms capable of growth in glucose agar tubes as anaërobes.

Mr. Fremlin has devoted much time and pains to this particular subject, and in a number of experiments shows plainly that amongst the extraneous micro-organisms present in glycerinated calf lymph as prepared in the Board's laboratories, there was not found a single micro-organism, spore bearing or otherwise, which could be regarded as anaërobic. Further, he finds that all the extraneous organisms, with the exception of bacillus subtilis, are fully capable of growth under the strictest anaërobic conditions, as well as aërobically. In another paper Mr. Fremlin has enquired into the pathogenic properties of some of these extraneous organisms, and he records the results of a series of experimental injections into rabbits and guinea-pigs of cultures of staphylococci found in calf lymph.

Limits of Resistance of the Specific Element of Vaccine.

The second part of our investigations was designed to ascertain the limits of resistance of the specific vaccine virus under various influences. On this subject our work deals with—

(1.) The effect of the absence or presence of air on glycerinated calf lymph;

(2.) The effect of heat on fresh unglycerinated calf lymph;

(3.) The effect of various disinfectants and other chemical substances on calf lymph in comparison with the effect produced by glycerine;

(4.) The effect of desiccation on fresh calf lymph;

(5.) The effect of Röntgen rays on glycerinated calf lymph.

Dr. Green contributes a study of the histology of the blood of calves before and after vaccination.

Some experimental work has also been done by Mr. Fremlin, Dr. Green, and myself to ascertain what animals are susceptible to vaccinia. So far, we have found, besides the human being the monkey and the calf, that the dog, the pig, the rabbit, the guinea-pig, the mouse, the hen, and the duck yield all of them vesicles more or less typical; and further that from the local reaction produced in each material can be obtained capable of giving rise to typical vesicles when transferred to the calf. Of the animals used, the pigeon alone has so far proved insusceptible.

ON THE USE OF GELATINE FOR THE CULTIVATION OF THE EXTRANEOUS MICRO-ORGANISMS OCCURRING IN GLYCERINATED CALF LYMPH;

By MR. H. S. FREMLIN.

In the report of the Medical Officer (1899–1900) I furnished a paper dealing with the bacteriological flora of glycerinated calf lymph as observed by growth on nutrient agar-agar. The present paper treats of the growth of the extraneous organisms of glycerinated calf lymph on media containing gelatine. The investigation was undertaken to ascertain whether the use of such media showed any difference as regards numbers and species of micro-organisms from what has already been recorded as resulting from growth on agar, and, if so, to what degree.

For these experiments, the medium chiefly used has been 10 per cent. gelatine in peptone beef broth, prepared in the usual way, and standardised by phenol phthaleine. But similar media containing gelatine in less proportion, 7½ per cent. and 5 per cent., have also been employed to learn whether the different proportions of gelatine exerted any influence on the growth of the organisms.

Plate cultures were established in the usual way, and one experimental series was incubated at 18° C., and another at 22° C.

The use of gelatine as a culture medium has two disadvantages. The first is that it melts or liquefies at a low temperature, about 25° C., and in laboratories, more especially in summer, the room temperature not infrequently exceeds this. It is necessary, therefore, to incubate gelatine plates in special incubators cooled by ice or water, but even the best of these are liable to considerable variations of temperature.

The second disadvantage is that a great number of micro-organisms have the property of liquefying the gelatine, and this very rapidly. When this occurs, enumeration of colonies and isolation and identification of species are rendered impossible. Both these drawbacks are more marked with media containing the smaller proportion of gelatine.

The following tables show the number of colonies obtained on gelatine and agar plates, inoculated with the same quantities of the same samples of glycerinated calf lymph, established at the same time, and incubated under the same conditions.

The figures given are averages derived from 80 experiments.

PLATES INCUBATED AT 18° C.

Time Incubated.	Number of Colonies Found.	
	Agar.	Gelatine.
24 hours	—	—
48 hours	220	750
5 days...	20,000	41,000

PLATES INCUBATED AT 22° C.

Time incubated.	Number of Colonies Found.	
	Agar.	Gelatine.
24 hours	600	7,500
48 hours	46,000	43,500
4 days...	63,000	Entirely liquefied.

From this it would appear that at 18° C. organisms develop more rapidly and in greater number on gelatine than on agar, and that at 22° C. this more rapid growth during the first 24 hours is very marked.

The rapid liquefaction of the gelatine which took place before all the colonies had had sufficient time to properly develop prevented their enumeration, but there is little doubt that the number of organisms developing on the gelatine would have been as great as that on agar.

The plates incubated at 18° C. may be kept some days before they show much sign of liquefaction, but the temperature is too low to be favourable to the growth of the staphylococci.

The plates incubated at 22° C. usually show sign of liquefaction after the second day, and therefore the time is hardly sufficient to allow all the colonies to develop.

Gelatine plates incubated at a lower temperature than 18° C. generally show no growth, and incubated at higher temperatures than 22° C. show evident liquefaction within a few hours.

The species noted on gelatine plates in all cases corresponded with those usually found on agar. The most abundant was staphylococcus pyogenes aureus; other species usually present were staphylococcus pyogenes albus, staphylococcus cereus albus, staphylococcus cereus flavus, and an unnamed bacillus forming hyaline colonies.

Gelatine appears to be a favourable medium for the development of organisms present in calf lymph, as the number capable of growth upon it are certainly not less than that found on agar inoculated in the same way, at the same time, and incubated at the same temperature.

Experiments with 7½ per cent. gelatine, showed practically the same results as were obtained with 10 per cent. gelatine. Organisms grow freely on it; and it serves as a very suitable medium for the differentiation of liquefying from non-liquefying organisms, since organisms possessing the property of liquefaction only in a moderate degree rapidly display their power and can be readily distinguished.

The great disadvantage of this medium is the readiness with which it liquefies at comparatively low temperatures, The plates cannot be incubated above 20 degree C. from this cause.

The preparation of 5 per cent. gelatine is attended with considerable difficulty, since the slightest overheating during the process of manufacture and sterilisation is sufficient to prevent the gelatine from setting. Plates established from this gelatine show almost exactly similar results to those obtained with 7½ per cent. and 10 per cent. gelatine. The organisms develop extremely well, and any liquefactive power they possess is shown very early. This medium like the last is useful to separate liquefying from non-liquefying organisms.

The rapid liquefaction of this gelatine renders it useless for the enumeration of colonies of Staphylococci, the original plate showing distinct sign of liquefaction within a short time of its inoculation.

Sugar Gelatine.

This medium which contained 10 per cent. gelatine, and 2 per cent. glucose was prepared in the same way as ordinary gelatine.

It was used to observe whether the addition of sugar was favourable or otherwise to the growth of organisms, and to note whether any species occurred which had not been met with on ordinary media.

The results of eight experiments showed that all the usual species found on beef broth agar or on gelatine, when inoculated with lymph and incubated at 22° C., occurred also on this medium.

The chief difference noted was that the colonies, although equally numerous, were usually poorly developed. This was seen markedly on the dilution plates.

This medium therefore has no distinct advantages.

Thus these experiments indicate that gelatine media are by no means to be regarded as inferior to agar media for the development of the extraneous organisms of glycerinated calf lymph, on the contrary the gelatine plates show, after the same period of incubation at the same temperature (22° C.) a greater number of colonies than the corresponding agar plates. Special note may be made of the fact that for the satisfactory employment of gelatine media great care must be exercised in alkalinisation, and that the temperature of incubation must not be less than 18° C.

ON THE INFLUENCE OF ANAËROBIC CONDITIONS ON THE EXTRANEOUS ORGANISMS OF GLYCERINATED CALF LYMPH;

BY MR. H. S. FREMLIN.

In the last report of the Medical Officer I gave a detailed account of the extraneous micro-organisms which occurred in glycerinated calf lymph as evidenced by growth on surface agar under aërobic conditions. A further series of experiments has been instituted to ascertain whether glycerinated calf lymph contains any extraneous micro-organisms capable of growth under anaërobic conditions; and, if so, whether these are strictly anaërobic, that is to say, are incapable of growth under ordinary aërobic conditions as on the surface agar above alluded to. Further if such anaërobic micro-organisms occur, whether they are, or are not, killed by the glycerination to which the lymph pulp is subjected.

This subject is of value not only from a bacteriological point of view, but also in determining whether anaërobic organisms, which might or might not have a pathogenic action, do not in some obscure way find, at one time or another, entrance into lymph.

In the report of *The Lancet* Commission on glycerinated calf lymphs, it is stated that certain spore-bearing and anaërobic micro-organisms were found which did not make their appearance on either agar or gelatine plates. This statement being at variance with our previous experience it was thought advisable to carry out further work on the subject.

The aim of the work was threefold :—

(1) To note the number of extraneous micro-organisms of lymph capable of growth on media kept under anaërobic conditions, as compared with those occurring in the same media aërobically treated.

(2) To observe the different species capable of growth under these respective conditions.

(3) To ascertain whether growth of any species was strictly limited to the media placed under anaërobic conditions, or to the media under aërobic conditions, that is to say, whether any of the organisms occurring might be regarded as obligatory anaërobes or as obligatory aërobes.

To these ends the following media were employed :—

Peptone beef broth agar, hereinafter called "agar."

Two per cent. glucose peptone beef broth agar, hereinafter called "sugar agar."

Agar containing one per cent. sodium formate.

Agar containing one per cent. indigo sulphate of soda.

Ten per cent. peptone beef broth gelatine, hereinafter called "gelatine."

Ten per cent. sugar gelatine; the above with the addition of 2 per cent. glucose.

Peptone beef broth.

Peptone beef broth, containing 1 per cent. sodium formate.

Peptone beef broth, containing 1 per cent. indigo sulphate of soda.

With these a large number of experiments has been made, extending over a considerable period of time. The amount of work entailed has been much enhanced by the difficulty of ensuring complete anaërobiosis, and by the necessity of proving that strictly anaërobic conditions prevailed.

To do this it was found necessary to take a strictly anaërobic organism, such as bacillus tetani, to serve as a control. If then, the conditions were such that bacillus tetani could grow, the anaërobiosis was considered complete. Where, however, growth of this organism did not occur (other things being equal), it was considered as evidence that oxygen had not been entirely excluded.

Anaërobic plate cultivations.

For the proper establishment of plates under anaerobic conditions, it was found necessary to render the atmosphere free from oxygen by means of hydrogen. The use of alkaline pyrogallic solution, though repeatedly tried, was not found to give satisfactory results.

Considerable difficulty was experienced in carrying out the hydrogen method. The essential point is that the liquefied medium contained in the plate shall not "set" until it is thoroughly permeated with the gas and is thus deprived of every trace of oxygen. Various methods of subjecting the plates to the influence of hydrogen have been tried with fair success, but none has been found that is always reliable.

The apparatus chiefly used was in the form of a bell jar perforated at the top by two glass tubes controlled by stop-cocks to allow of ingress and egress of the gas of the experiment, after the pattern of Bulloch's modification of Botkin's apparatus. A further modification was introduced in that the bell jar stood in a glass dish instead of on a flat plate of glass.

When in use this glass dish was filled with liquid paraffin, mercury, or other substance, so that there was provided a most efficient seal against escape of the gas, much more so than could be obtained by the use of a vaselined glass plate.

The method of using this apparatus was as follows :—

A tube containing culture medium, agar or gelatine, was liquefied by heat in the usual way, and, when sufficiently cool, the medium was inoculated with one platinum loopful of freshly glycerinated calf lymph. The loopful of lymph was well distributed in the medium and two subsidiary tubes were inoculated from the contents of this tube in the usual way. The contents of each tube were then poured into sterile Petri dishes.

Each lymph examined was thus represented by three plates consisting of the original and the first and second dilution plates; in many instances such a series of plates was made in duplicate or triplicate. Immediately that the plates were poured they were placed on trays under the bell jar, the apparatus sealed, and hydrogen, supplied from a Kipp's apparatus, allowed to enter. The flow of gas was continued until experiment showed that every trace of oxygen had been expelled from the bell jar.

As already stated, unless this was effected before the media in the plates had set, the experiment was considered a failure.

But when the establishment of anaërobiosis was successfully accomplished, the whole apparatus was in the case of agar incubated for 48 hours at 37° C., and afterwards was removed and incubated at 20° C. for seven days. In the case of gelatine, incubation was for seven days at 20° C. only.

At the same time that these anaërobic plates were established from the glycerinated lymph, control plates were also set up and kept under aërobic conditions, the medium, time, and temperature of incubation being the same.

Results.—It was found that the numbers of colonies which developed on the plates under anaërobic conditions corresponded to those which developed on the control plates under aërobic conditions. Practically no difference could be distinguished between them.

Further, it was found that the various species were the same under both conditions, the only difference being that bacillus subtilis was never found on the anaërobic plates.

To ascertain whether the species were the same, and lest any should escape notice, the plates were carefully examined, both with the naked eye and by the A. A. Zeiss magnification. Any colonies about which doubt existed, and any not recognised, were picked up and inoculated on to sloping gelatine or agar.

These in every instance under aerobic conditions proved to be colonies of organisms usually met with in lymph ; namely, staphylococcus pyogenes aureus, staphylococcus pyogenes albus, or staphylococcus cereus albus.

The chief difference noted between the colonies on anaërobic and aërobic plates was best seen on the dilution plates. On these,

under anaërobic conditions, the colonies of staphylococcus pyogenes aureus, staphylococcus pyogenes albus, and staphylococcus cereus albus were so similar that it was often impossible to distinguish between them.

The aureus colonies failed to show their distinctive orange colour, and all the colonies appeared white, greyish white, greenish white, or faintly tinged with buff; it was only by means of subcultures on gelatine incubated under aërobic conditions that the actual species could be determined.

The species found on these plates were :—

Staphylococcus pyogenes aureus,
Staphylococcus pyogenes albus,
Staphylococcus cereus albus,
Bacillus unnamed (hyaline colonies),
Bacillus mesentericus vulgatus,
Bacillus mesentericus ruber.

No species of bacteria, spore-bearing or otherwise, were observed on the anaërobic plates which had not already been noticed on plates kept under aërobic conditions.

On the other hand bacillus subtilis was the only organism which occurred on aërobic plates inoculated with glycerinated calf lymph that was not found on the anaërobic plates. Bacillus subtilis, as is well known, is an obligatory aërobe.

Experiments with Sugar Agar.

In the same way plates of sugar agar were established in 16 instances and placed under anaërobic conditions.

Sugar agar serves as a most excellent medium for the growth of anaërobic organisms, and therefore it was possible that use of this medium might conduce to growth where ordinary agar had failed.

It was found, however, that the number of colonies which developed on this medium under anaërobic conditions corresponded to that which developed on the same medium under aërobic conditions, and further that this correspondence applied equally to ordinary agar.

Though no difference in number could be distinguished, it was noted that the growth of the colonies on the sugar agar plates did not appear to be so good as on ordinary agar, suggesting that the organisms present found no advantage in the sugar. On the dilution plates of sugar agar under anaërobic conditions the want of pigment in the colonies of the staphylococci was conspicuous,

the colonies presenting the same appearances as were noted with ordinary agar under anaërobic conditions. This want of pigment was also noticed in the colonies developing on sugar agar under aërobic conditions. Further, no previously unobserved species of organisms could be recognised.

Colonies from both original and dilution plates were frequently inoculated on to media kept under aërobic conditions. In all cases these developed colonies of like species to those found on the control agar and sugar agar plates kept likewise under aërobic conditions.

No organism was found growing on the sugar agar plates which did not also appear on the ordinary agar.

Agar containing 1 *per cent. Sodium Formate.*

The addition of sodium formate to agar has been suggested on the ground that the formate can absorb all the oxygen in the medium and can thus provide suitable conditions for the growth of anaërobic organisms.

To test the value of this medium for anaërobic work, trial tubes were inoculated with bacillus tetani by ordinary stab cultures. After incubation at 37° C. for seven days it was found that no growth took place. But when such cultures were placed under strict anaërobic conditions growth occurred.

It was evident, therefore, that sodium formate of the strength used did not absorb all the free oxygen present in the tube.

Hence it was considered useless for the purposes of these experiments.

Agar containing 1 *per thousand Indigo Sulphate of Soda.*

This medium, like the last, gave evidence of the presence of free oxygen and was therefore considered useless.

Experiments with 10 *per cent. Peptone Beef Broth Gelatine.*

Plates of gelatine were established from glycerinated calf lymph in 12 instances in the usual way, placed in the anaërobic apparatus and incubated at 20° C. for seven days.

The colonies that developed on this medium under anaërobic conditions corresponded almost exactly with those which appeared on gelatine under aërobic conditions both in number, kind, and rate of liquefaction.

On both original and dilution plates the colonies were perhaps a little smaller than those growing in the presence of air, otherwise no difference was noticed. Although numerous sub-cultures were made no micro-organisms, spore-bearing or otherwise, were observed that were incapable of growing both aërobically and anaërobically.

Further, the organisms which are capable of causing liquefaction of the gelatine under aërobic conditions, preserved the same power under anaërobic conditions and to the same degree.

Experiments with Sugar Gelatine.

There was no marked difference noticeable between colonies occurring on this medium and those on anaërobic gelatine. The species in both cases corresponded. Twelve experiments were made.

Experiments with Peptone Beef Broth.

Peptone beef broth was used for 12 experiments as an anaërobic cultivation medium in the following ways :—

I. Tubes of beef broth immediately after inoculation with glycerinated calf lymph, were rendered anaërobic by the passage of a current of hydrogen through them until test of the escaping gas showed that every trace of oxygen had been expelled.

II. Tubes of beef broth containing one per cent. sodium formate.

III. Tubes of beef broth containing one per thousand indigo sulphate of soda.

In addition to these, tubes of beef broth were inoculated with the same quantity of glycerinated calf lymph and placed under aërobic conditions to serve as controls.

I.—Experiments with Beef Broth Rendered Anaërobic by Means of Hydrogen.

In the first place, in order to ascertain whether any multiplication of organisms took place in the tubes after incubation under anaërobic conditions, it was necessary to estimate the number of organisms present in a given quantity of the beef broth immediately after inoculation.

For this purpose tubes of beef broth, which each contained 10 cc., were inoculated with one loopful of glycerinated calf lymph, which was thoroughly mixed with the medium in the

usual way. One loopful was then taken of this mixture and an aërobic agar plate established from it. After incubation for 48 hours at 37° C., this plate showed the number of micro-organisms contained in one loopful of the beef broth immediately after inoculation.

The inoculated tubes of beef broth were then made anaërobic by the passage of hydrogen through them, and incubated, some for 48 hours at 37° C., and some for 7 days at 20° C. After such incubation the tubes were well shaken and one loopful as before removed from each culture. From this a series of three agar plates was established in the usual way. These plates were then incubated for 48 hours at 37° C. in the same way as the preceding one and examined. The original plate of such series showed the number of organisms present in one loopful of the beef broth after its incubation under anaërobic conditions, and from the dilution plates the species of the organisms could be identified. Further, a stained microscopic specimen was made from each tube of the experiment to display the morphology of the organisms and to assist in their identification.

Results of Beef Broth tubes treated anaërobically and incubated for 48 hours at 37 degrees C.

Twelve experiments performed in this way, showed an average of 10 colonies per loopful before treatment, and 450,000 colonies per loopful after treatment. The species found before treatment in the eight tubes were all Staphylococci. After treatment Staphylococci were found in all the tubes with the exception of one, but proteus bacilli also were found in five of the eight tubes. In one instance this organism occurred in practically pure culture.

The microscopic specimens made from the tubes after treatment corresponded with those of the agar plate cultures. That is to say if a specimen from one tube showed cocci, the corresponding plates of this tube revealed aureus and albus. If a specimen showed bacilli, alone or mixed with staphylococci, the corresponding plate showed colonies of a similar bacillus alone or of this bacillus together with colonies of aureus and albus. The bacillus found was in all cases the same from the various tubes, and was a species belonging to the Proteus group.

No spore-bearing bacilli were ever seen in the microscopic specimens made from the beef broth cultures, nor any form of micro-organism differing from those whose growth was noted on the agar plates.

Results of Beef Broth tubes treated anaërobically and incubated at 20° C. for 7 days.

These tubes were inoculated and examined in exactly the same way as those incubated at 37° C. Twelve experiments

performed in this way showed no organisms per loopful before treatment, but 1,150,000 colonies after treatment.

These figures indicate an enormous multiplication of organisms, since one loopful of the mixture at the time of inoculation did not contain a single organism. The total number therefore of organisms present in the mixture at that time must have been extremely small.

The species were found to be precisely the same as in the preceding experiment, the same proteus bacillus being found in one tube.

In the microscopic specimens no organisms were seen other than those which showed growth on the control agar plates.

II. and III. Experiments with Beef Broth, containing 1 per cent. Sodium Formate, and 1 per thousand Indigo Sulphate of Soda.

Beef broth containing sodium formate like the sodium formate agar apparently contained free oxygen, so was not further used for anaërobic work, and the same objection was found with beef broth containing 1 per thousand indigo sulphate of soda.

With regard to the tubes of beef broth inoculated with glycerinated calf lymph and placed under aërobic conditions, it is sufficient to say that the agar control plates after incubation for 48 hours at 37° C. showed, as might be expected, an enormous multiplication of organisms.

From 10 experiments the average number of organisms per loopful at inoculation was 17, after inoculation 2,000,000.

Staphylococci were found in all instances, and two-thirds of the cultures showed the same bacillus, belonging to the Proteus group, which was found in the anaërobic beef broth cultures.

No species were found in these aërobic cultures which had not been seen in the anaërobic cultures.

SUMMARY.

Thus these experiments show :—

(1) That glycerinated calf lymph contains no organisms which can be described as anaërobic ; that is none which are capable of growth under strict anaërobic conditions and incapable of growth under aërobic conditions.

(2) That all the extraneous organisms are facultative anaërobes, that is can grow under either aërobic or anaërobic conditions, with the single exception of bacillus subtilis which is well known to be an obligatory aërobe.

(3) That the extraneous organisms grow equally well under aërobic and anaërobic conditions, in equal numbers and with colonies of similar appearance, with the exception that under anaërobic conditions produced by hydrogen the development of definite pigments is to a large extent lost.

(4) That glycerinated calf lymph contains no spore bearing organisms aërobic or anaërobic capable of growth on the various media used, other than the members of the mesenteric group commonly met with.

(5) That in glycerinated calf lymph there are frequently present bacilli which often escape notice in ordinary plate cultivations. They are usually few in number, and probably occur only in the original plate, where many colonies being crowded together and more or less ill developed they have no opportunity of displaying their characteristic form, and consequently are missed. But these bacilli, which belong to the proteus group, and very closely resemble proteus vulgaris, when placed in suitable media such as beef broth, and cultivated either aërobically or anaërobically, grow luxuriantly and multiply much more rapidly than the staphylococci.

EFFECT ON ANIMALS OF INJECTIONS OF CULTURES OF STAPHYLOCOCCI OCCURRING IN GLYCERINATED CALF LYMPH;

By Mr. H. S. Fremlin.

As has been already shown vesicular material as obtained from calves always contains certain staphylococci. Of these, the two kinds most common, are morphologically and culturally indistinguishable from staphylococcus pyogenes aureus and staphylococcus pyogenes albus of Rosenbach. Both of these species, as is implied by their names, can be associated with the production of inflammation and suppuration, and even with general infections of a more virulent character.

At the same time it is well known that they occur abundantly in the healthy skin of men and animals, exerting under normal circumstances no pathogenic action, and indeed in many cases appearing incapable of such action.

Now these organisms are found in large numbers in the healthy skin of calves, and their constant presence in calf lymph appears to be due to this circumstance of contiguity rather than to any definite association with the production of vesicles, though it is possible that the lowered resistance of the calf's tissue cells, which shows itself in the formation of vesicles through the agency of the vaccine virus, may afford suitable conditions for their more rapid growth and multiplication.

In this connection, therefore, it seemed expedient to ascertain whether staphylococci, as isolated from calf lymph, could exert any pathogenic action when transferred to lower animals even in comparatively large quantities.

For this purpose cultures of staphylococcus pyogenes aureus, staphylococcus pyogenes albus, and staphylococcus cereus albus, another organism frequently found in lymph, were injected into animals.

It was considered desirable that the organisms experimented with should be subjected to artificial conditions as little as possible, and that they should be only so far removed from their parasitic existence on the calf as was compatible with securing them in pure culture. Therefore these organisms were isolated directly from vesicles on the calf rather than from glycerinated lymph. For we know that glycerine exerts a very deleterious effect on the staphylococci, and this very speedily, hence it was conceivable that if isolated even from freshly glycerinated lymph the vitality and activity of these organisms might to some extent be impaired, not only by the action of

the glycerine but even by the mechanical processes of trituration. Vesicles then were removed from the calf in the usual way 120 hours after vaccination, and at once agar plates were established from them.

These plates were incubated at 37 degrees C. for 48 hours and were then examined, and colonies of staphylococcus. pyogenes aureus, staphylococcus pyogenes albus, and staphylococcus cereus albus were identified, and transferred to tubes of peptone beef broth, great care being taken that pure cultures were obtained in every instance.

These processes of isolation and cultivation were carried out from vesicular material obtained from 10 calves, so that the organisms experimented with were isolated from 10 separate lymphs.

The beef broth tubes so inoculated were incubated at 37° C. for 24 hours ; they were then examined for pure growth both by actual observation of the culture as it appeared to the eye and also by plate cultivation.

The beef broth cultures, showing copious growth, having been thus scrutinised, were at once employed for injection of healthy rabbits and guinea-pigs. Experiment showed that of such well-developed culture one platinum loopful contained on an average 94,500,000 organisms.

This paper deals only with injections made under the skin of the abdomen. The rabbits were injected with 2 cc.'s in every instance, the guinea-pigs with 1 cc. each.

The temperatures of the animals were taken at the time of the inoculation and once every day whilst they were under observation.

In all cases they were kept for 21 days; in order to watch not only any inflammatory conditions occurring within the first week but also any further pathological changes which might ensue at a somewhat later date. They were then killed and a post-mortem examination made.

Details of these experiments are given in the following table :—

Results.
illed on 21st day : P.M., normal.
"   "   "
"   "   "
"   "   "
"   "   "
illed on 21st day : P.M., some fluid in peritoneal cavity.
illed on 21st day : P.M., normal.
"   "   "
"   "   "
"   "   "
"   "   "
"   "   "
"   "   "
"   "   "
"   "   "
"   "   "
"   "   "
"   "   "
"   "   "
"   "   "
"   "   "
"   "   "
"   "   "
illed on 21st day : P.M., excess of peritoneal fluid, otherwise normal.
illed on 21st day ; P.M., inspissated inflammatory exudation at site of inoculation, otherwise normal.
illed on 21st day ; P.M., normal.
"   "   "
"   "   "
illed on 21st day ; P.M., normal ; site of inoculation thickened and raw.
"   "   "
illed on 21st day : P.M., normal.
illed on 21st day ; P.M., normal ; site of inoculation hairless.
illed on 21st day ; P.M., normal.
illed on 21st day ; site of inoculation not found : large caseous mass in subcutaneous abdominal tissue.

Altogether 11 rabbits and 23 guinea-pigs were inoculated with cultures of staphylococci.

Of the 11 rabbits, 5 were inoculated with staphylococcus pyogenes aureus, 4 with staphylococcus pyogenes albus, and 2 with staphylococcus cereus albus; and of the 23 guinea pigs, 14 were inoculated with staphylococcus pyogenes aureus, 5 with staphylococcus pyogenes albus, and 4 with staphylococcus cereus albus.

In no instance did death occur, nor was there in any case evidence of suppuration, and the health of all appeared to be good whilst under observation. The majority of the animals showed a rise of temperature after the first or second day, and elevation of temperature continued intermittently for a week or more, when the temperature usually fell to normal.

In no instance was the temperature above normal at the time the animal was killed. The post mortem records show that, save for slight and local lesions occurring in a few of the animals, all of them were healthy.

The rabbits, as might be expected, owing to their receiving a larger dose, were more affected than the guinea-pigs by the injections. In only one instance out of the 23 inoculations did a guinea-pig show any evidence, post mortem, of any departure from the normal.

These results go far to show that the staphylococci usually associated with calf lymph as employed above, possess little or no virulence as regards rabbits and guinea-pigs.

ON THE INFLUENCE OF ANAËROBIC AND AËROBIC CONDITIONS ON GLYCERINATED CALF LYMPH.

By MR. H. S. FREMLIN.

These experiments were instituted for the purpose of ascertaining whether samples of glycerinated calf lymph subjected to anaërobic conditions retain their specific powers for as long as, or longer than, corresponding samples of the same lymphs kept under ordinary or aërobic conditions; and, further, whether the rate of reduction of the amount of extraneous organisms proceeded similarly in the presence or absence of air or with what degree of difference.

The anaërobic conditions were produced in two ways :—

1. By passing hydrogen through the glycerinated lymph emulsion in such a way as to drive out all air, leaving the lymph in an atmosphere of pure hydrogen.
2. By abstracting oxygen from the air in the vessel in which the glycerinated lymph was placed by means of an alkaline solution of pyrogallic acid, leaving the lymph in an atmosphere of, practically, nitrogen only.

In both cases the vessels containing the lymph were hermetically sealed so that ingress of air was excluded during the whole time that the lymphs were under observation.

A sample "Stock" tube of each lymph experimented with was set aside under ordinary or aërobic conditions to serve as a control.

All the lymphs, both those treated aërobically and anaërobically, with which experiment was made were kept at a temperature of 10° C.

Potency of Lymph after Storage in an Atmosphere of Hydrogen.

The experiment was carried out on five samples of lymph. When these had been kept under the conditions stated for upwards of two months they were tested on calves with the result that each sample yielded good vesicles and the effect of the lymphs kept under anaërobic conditions was indistinguishable from that of the controls.

Effect, on the Extraneous Organisms, of Storage in an atmosphere of Hydrogen.

At the time when these glycerinated lymphs were tested on calves, agar plates, each containing the same quantity of emulsion,

one platinum loopful, were established in the ordinary way. After suitable incubation, the lymphs which had been kept under anaërobic conditions showed in all five cases colonies of staphylococcus pyogenes aureus and staphylococcus pyogenes albus. In three cases numerous colonies of penicillium glaucum were also present, whilst the other two lymphs showed colonies of bacillus mesentericus. The average number of colonies present on these plates was 13.

On the other hand, the plates established of the control lymphs showed an average of six colonies per loopful. These were practically all staphylococci, and in no case did there any growth of penicillium glaucum appear.

Thus although glycerinated lymph kept in an atmosphere of hydrogen appears to retain its efficacy well, yet the elimination of micro-organisms is no quicker than when stored under aërobic conditions, and the persistence of penicillium glaucum and apparently its multiplication are decidedly disadvantageous.

Potency of Lymph after Storage in an Atmosphere of Nitrogen.

Eight samples of glycerinated lymph were placed uncorked in Buchner tubes, and the oxygen abstracted from the surrounding air by means of an alkaline solution of pyrogallic acid. The Buchner tubes were hermetically sealed so that the lymph was kept in an atmosphere of nitrogen.

Eight tubes of lymph were reserved as controls in the same way as before. After upwards of two months these lymphs were tested on calves, with the result that each lymph yielded good vesicles and no difference could be noted between the effect of the lymphs anaërobically treated and that of the control lymphs.

Effect on Extraneous Micro-Organisms of Storage in Atmosphere of Nitrogen.

Nine agar plates were established of these lymphs in the usual way at the time of their test on calves, and suitably incubated.

The average number of micro-organisms found in a loopful of each of the emulsions stored in nitrogen was 11; and in the same quantity of the control emulsions, 16.

None of the organisms presented any special features. They were those which are of the kind commonly observed in lymphs, namely, staphylococcus pyogenes aureus, unnamed bacillus forming hyaline colonies, and bacillus mesentericus.

Aërobic Conditions.

The "stock" tubes of glycerinated calf lymph which have served as controls in the foregoing experiments furnish the first example of lymph stored under aërobic conditions. These tubes were filled with the glycerinated emulsion, a sterile cork was then pressed down upon the emulsion in the tube so that there was, as far as possible, no free air in the tube. The cork and the mouth of the tube enclosing the cork were then hermetically sealed with melted paraffin.

The lymph was thus in contact with as little free air as possible, and ingress of fresh air was entirely prevented.

The results have been already recorded.

A second example of aërobiosis was obtained by allowing the lymph to be in contact with free but sterile air.

Potency of Glycerinated Calf Lymph exposed to Sterile Air.

For this purpose, five "stock" tubes of glycerinated calf lymph were plugged lightly with sterilised cotton wool in such a way as to allow of free access of air, but at the same time the wool was sufficient to prevent the entrance of micro-organisms.

Control tubes of these lymphs, corked and paraffined in the usual way, were set aside, and all the tubes were placed in a temperature of 10° C. After two months these lymphs were tested on calves, with the result that the lymph contained in the wool-plugged tubes yielded good vesicles in four cases, medium visicles in one, whilst the controls yielded good vesicles in all five cases.

Effect on Extraneous Micro-organisms of Lymph of Exposure to Sterile Air.

At the end of two months agar plates were established in the usual way, with the result that the wool-plugged tubes showed an average of 16 colonies, whilst the control lymph showed an average of 15 colonies. None of these colonies presented any special features.

Thus these experiments show that if glycerinated calf lymph be stored under strict anaërobic conditions, in an atmosphere of hydrogen or nitrogen, or in such a way that free air is excluded, or in such a way that free sterile air is admitted, its activity as shown by the results on calves is preserved equally under each

method; and, further, the elimination of extraneous micro-organisms is practically the same in all cases, though the use of hydrogen appears to be negatived by the persistence of moulds such as penicillium glaucum. The presence or absence of air, then, does not seem to exert any marked effect on glycerinated calf lymph.

The further experiment of subjecting lymph to the passage of a current of air or oxygen for a considerable time has yet to be performed.

THE EFFECT OF HEAT ON THE ACTIVITY OF CRUDE CALF LYMPH, AND ON THE CONTAINED EXTRANEOUS ORGANISMS;

By Dr. F. R. Blaxall.

This investigation was undertaken to ascertain the highest degree of temperature the specific vaccine virus as obtained direct from the calf could withstand without loss of potency, and whether in this respect it is capable of greater or less resistance to the influence of heat than the extraneous organisms.

The method of procedure was as follows :—

Vaccine vesicles were collected from the calf to the extent of about a gramme in weight, and this quantity was placed in a small sterilised test-tube, or "stock-tube" as we call it. To the vesicles was added about an equal bulk of sterilised distilled water, and the two were well shaken together. The vaccine vesicles were not ground up or in any way disintegrated, as it was desired to carry out the experiments with vesicles in as fresh and natural a condition as possible. A Kew registered chemical thermometer was placed inside the stock-tube, so that the bulb was in the centre of the vesicular pulp. The exposure to heat was effected in a water bath. A small beaker, containing distilled water, was floated inside another beaker containing distilled water. Heat was applied to the outer beaker by means of a Bunsen flame. When the inner beaker showed that the required temperature, or a point just above it had been reached, the stock-tube containing the lymph and thermometer was placed upright in it. After a few experiments it was found quite easy by manipulation of the burner to maintain a perfectly constant temperature during the time of the experiment.

The first series of experiments dealt only with the range of temperature compatible with potency.

The time of exposure to the heat in each case was five minutes.

The day after the exposure the lymph experimented with was tested on calves.

The results are set out in the following table :—

Table I.

No. of Experiment.	Temperature to which Exposed.	Time Exposed.	Result on Calves.
1	40° C.	5 minutes ...	Good vesicles.
2	50° C.	" ...	" "
3	"	" ...	" "
4	"	" ...	" "

TABLE I—*continued.*

No. of Experiment.	Temperature to which Exposed.	Time Exposed.	Result on Calves.
5	55° C.	5 minutes ...	Good vesicles.
6	"	" ...	" "
7	"	" ..	" "
8	56° C.	" ...	" "
9	"	" ...	" "
10	57·5° C. ...	" ...	" "
11	" ...	" ...	" "
12	" ...	" ...	" "
13	58·5° C. ...	" ...	Weak vesicles.
14	" ...	" ...	Nil.
15	" ...	" ...	"
16	60° C.	" ...	"
17	"	" ...	"
18	"	" ...	"

From this it is seen that the lymph was potent on calves after an exposure of five minutes to a temperature of 57·5° C., but failed entirely after exposure to 60° C. for five minutes.

The uniformity of the results is remarkable.

The second series of experiments was designed to show the effect of these temperatures on the extraneous organisms. The procedure was the same, with the addition that before the exposure of the lymph to the heat, the stock tubes were violently shaken so that the water became clouded from admixture with the vesicular material. A platinum loopful of the mixture was then withdrawn, and agar plates established in the usual way. Again, at the expiration of the five minutes exposure, another platinum loopful was withdrawn and agar plates were established as before ; after incubation for two days at 37° C., and for a further period of five days at room temperature, the colonies that had developed were enumerated and compared. As before, the day after the exposure of the lymph to the heat, trial of the vesicular material for potency was made on calves.

The results are set out in the following table :—

TABLE II.

No. of Experiment.	Temperature to which Exposed.	Time Exposed.	Result on Calves.	No. of Colonies. Before Exposure.	No. of Colonies. After Exposure.
1	57·5° C. ..	5 minutes..	Good vesicles	184 ..	19 (very small).
2	" ..	" ..	Weak vesicles	186 ..	31
3	" ..	" ..	Good vesicles	63 ..	9
4	" ..	" ..	" "	2,800 ..	45
5	" ..	" ..	" "	31 ..	5
6	" ..	" ..	Weak vesicles	940 ..	72
7	" ..	" ..	" "	746 ..	53
8	" ..	..	Good vesicles	374 ..	28
9	" ..	" ..	" "	2,401 ..	4
10	58·5° C. ..	" ..	Few weak vesicles.	93 ..	4
11	" ..	" ..	" "	29 ..	4
12	" ..	" ..	Nil	37 ..	13 (very small).
13	" ..	" ..	"	860 ..	31
14	" ..	" ..	"	791 ..	22
15	60° C. ..	" ..	"	157 ..	18 (very small).
16	" ..	" ..	"	175 ..	26
17	" ..	" ..	"	29 ..	0
18	" ..	" ..	"	74 ..	9
19	" ..	" ..	"	82 ..	3
20	" ..	" ..	"	911 ..	12
21	" ..	" ..	"	830 ..	35

It will be seen from this table that while the potency of the specific germs was preserved in vesicular material, exposed to a temperature of 57·5° C. for five minutes, the extraneous organisms underwent considerable and in some cases, very great reduction in numbers.

In two instances the effect of a second exposure for five minutes was tried a week after the first.

The results are set out in the following table :—

TABLE III.

No. of Experiment.	—	Temperature to which Exposed.	Time Exposed.	Result on Calves.	No. of Colonies.	
					Before Exposure.	After Exposure.
	Lymph A.					
1	1st Exposure	57·5° C.	5 minutes	Good vesicles	940	72
	2nd "	"	"	" "	98	72
2	1st "	58·5° C.	"	Few papules	860	31
	2nd "	"	"	" "	34	2
3	1st "	60° C.	"	Nil	911	12
	2nd "	"	"	"	29	11
	Lymph B.					
4	1st Exposure	57·5° C.	5 minutes	Good vesicles	746	63
	2nd "	"	"	" "	54	38
5	1st "	58·5° C.	"	Few papules	791	22
	2nd "	"	"	" "	36	27
6	1st "	60° C.	"	Nil	830	35
	2nd "	"	"	"	14	29

In one instance the lymph was continuously exposed for 10 minutes, and the results are given in the following table :—

TABLE IV.

No. of Experiment.	Temperature to which Exposed.	Time Exposed.	Result on Calves.	No. of Colonies.	
				Before Exposure.	After Exposure.
1	57·5° C.	10 minutes	Few vesicles	14,000	116
2	58·5° C.	"	Nil	15,300	48
3	60° C.	"	"	13,200	11

These experiments show :—

(1) that it is possible for the vaccine organism to withstand a comparatively high temperature, 57·5° C., for five minutes without loss of potency ;

(2) that the lethal point is a very exact one—all the lymph gave good results after exposure for five minutes to a temperature of 57·5° C., and all failed entirely after exposure for the same time to a temperature of 60° C. At 58·5° C. only a feeble result was obtained or none ;

(3) that there appears to be, on the part of the vaccine organism, a greater power of withstanding the effects of high temperature than that possessed by the extraneous organisms.

THE DISINFECTANT ACTION OF CHLOROFORM, AND VARIOUS OTHER SUBSTANCES, ON THE SPECIFIC AND EXTRANEOUS MICRO-ORGANISMS OF VACCINE;

By Dr. Alan B. Green.

The action of glycerine as used in the preparation of vaccine for the vaccination of the human subject is fairly well defined. When employed in its pure state, or in certain degrees of dilution with sterile distilled water, its action, generally speaking, is germicidal to the non-sporing adventitious bacteria of crude vaccine. The specific organism of vaccine, however, in marked contrast, is capable of resisting this destructive action of glycerine, and may remain potent for vaccination for considerable periods of time. Together with the specific organism, spore bearing organisms as a rule show considerable powers of resistance. These spore bearing organisms, which occasionally occur in vaccine, are practically entirely confined to the mesenteric group of bacteria, whose high power of resistance to sterilising influences is well known. The length of life of the non-sporing extraneous organisms in the presence of glycerine, varies within well defined limits. As a rule the elimination proceeds rapidly at the outset, and then gradually diminishes, leaving a comparatively small number of organisms to be dealt with towards the end of the process. A vaccine is not entirely freed from such extraneous bacteria in less time than from four to six weeks. At that time, or indeed for long after, the specific vaccine virus usually retains its vitality unimpaired, having resisted the destructive action of the glycerine. Since this is so it seemed very desirable to know if this action were peculiar to glycerine, or whether the specific vaccine virus might be capable of withstanding the action of other substances more or less germicidal to ordinary organisms.

With this in view, experiments were instituted in July 1900 by preparing vaccine with various substances in place of glycerine, and up to the present time some 31 substances have been used for nearly 150 experiments. These, however, do not complete the series, for several more substances remain to be added to the list, and in the case of some of those already used, repetition may be desirable ; consequently this paper must be regarded rather as a preliminary report than as a final statement.

The following has been the procedure with these experiments :—

In the case of Non-Volatile Substances.

A. Preparation.

1. Vaccine pulp was collected from calves under the aseptic conditions observed at these laboratories.

2. The pulp was divided into two portions of known weight (*a*) to be used in bulk or in smaller weighed quantities for admixture with experimental substances, and (*b*) to be mixed with four times its own weight of a sterilised solution of 50 per cent. pure glycerine and distilled water—the laboratory method of preparing glycerinated vaccine. This portion served as a control.

No less weight than one gramme of vaccine pulp was used with any substance for any one experiment, or with glycerine solution for a control.

3. All solid and some fluid experimental substances were used in solutions of known strength.

4. Each weighed quantity of vesicular material was ground up by means of a sterilised pestle and mortar with a weighed quantity of either the experimental substance, or of 50 per cent. glycerine and water solution gradually added.

5. Each portion of vaccine, when intimately mixed with the requisite quantity of solution, was poured into sterilised glass "stock tubes" of 3–5 cc. capacity and of the shape of test tubes. A sterile cork was then firmly inserted into the mouth of each tube in such a way that the top of the column of fluid and the bottom of the cork were in contact, with the intention of excluding air as far as possible. The corked end of each tube was then sealed with melted paraffin.

6. After mixing, all vaccines were kept in a dark cupboard at room temperature and were only temporarily removed when required for various testing purposes.

B.—*Examination for Extraneous Organisms.*

1. The number of extraneous organisms present in a platinum loopful of each vaccine, immediately after mixing, was ascertained by means of nutrient agar-agar plate cultures incubated for 48 hours at 37°C., and for 72 hours further at room temperature. The same platinum loop was used throughout the experiments, and in every case one platinum loopful of the mixture was the quantity used in testing vaccines for organisms; except in a few cases, expressly stated, when a capillary tubeful was used, and also in cases where vaccine pulp and experimental solutions did not form a fluid mixture, when a needleful was used on each occasion.

2. Similar plate cultures were made from vaccines 24 and 48 hours after mixing, when necessary, and always from each vaccine on the 8th day after mixing. Frequently plates were poured at the end of the 2nd, 3rd, and some subsequent weeks after mixing. Corresponding cultures were made of controls in every case.

C.—*Examination for Potency.*

1. The potency of each vaccine and its control was tested by inoculating calves in the laboratory routine way as opportunity offered, and this was, of necessity, at irregular intervals, the number of experiments rendering a uniform method of procedure here impossible. In Tables A, B, C, D, E, and F, the latest time of testing each vaccine is noted. This does not by any means indicate the limit of potency, unless a limit be expressly stated, but merely the latest date of testing. In some cases, especially mentioned later, vaccines whose good qualities had been shown several times by inoculations on calves, were used for the vaccination of children.

In the case of Volatile Substances.

In the case of solutions of volatile substances the only modification of the foregoing procedure was :—

(*a.*) Instead of weighing quantities of solutions, the approximately equivalent volume of a certain known weight was determined ; this volume or a multiple of it could at any time be easily and rapidly measured in a pipette.

(*b.*) The weighed quantity of pulp was ground up and intimately mixed, by means of a sterile pestle and mortar, first with *sterile distilled water only, in amount equal to half the volume required of solution.* The experimental solution, made of double the strength required by the experiment, was then quickly added to complete the required volume. Thus the final solution was of the strength required, and the volatile portion being added at the end of the process, rendered the time for evaporation of the volatile body as short as possible. After this final mixing, the vaccine was rapidly poured into stock-tubes, which were immediately corked and sealed.

It should be remarked that this series of experiments deals solely with the specific organisms of crude vaccine, and such extraneous organisms as happen to be in it at the time of collection. These extraneous bacteria have been worked out in detail by Mr. H. S. Fremlin, and appear in a paper deduced from the examination of 500 separate vaccines in the Report of the Medical Officer of the Local Government Board, 1899–1900.

Further, the vaccines used for these experiments were of very indifferent quality, being only such as were available from time to time, and of not sufficiently good quality for issue in the ordinary course. It may be safely affirmed, therefore, that the results as regards potency in these experiments, would have been considerably better had it been possible to use vaccine such as is ordinarily issued.

For convenience of comparison and reference, the various substances used in these experiments have been grouped into the following classes :—

CLASS A.—*Inorganic Acid and Alkali.*

CLASS B.—*Disinfectant Salts.*

CLASS C.—*Disinfectant and Other Substances.*

CLASS D.—*Carbohydrates.*

CLASS E.—*Chloroform.*

CLASS A.—*Inorganic Acid and Alkali.*

In the first place it was desired to ascertain what amount of simple inorganic acid or of alkali the specific organism of crude vaccine could withstand without loss of potency, and secondly, in what degree these strengths would be germicidal to the extraneous organisms. Hydrochloric acid and sodium carbonate were selected for the acid and alkali respectively. Solutions of these were made with distilled water. The number of experiments, the various strengths of the solutions, and the results of their actions on the organisms are shown in Table A. Each vaccine was tested by plate cultivations for extraneous organisms at the end of the first week after mixing, and for potency at the end of the second week.

Fourteen experiments were made with hydrochloric acid, and fifteen with sodium carbonate in various strengths. In each case one part by weight of vaccine pulp was mixed with four times that weight of solution. It will be observed that a ·75 per cent. solution of hydrochloric acid and distilled water seems to be the border line of acidity at which the specific vaccine organism may or may not survive after 14 days contact ; for while every vaccine mixed with a solution of hydrochloric acid under ·75 per cent. strength gave vesicles after inoculation, the three vaccines mixed with the ·75 per cent. solution gave varying results ; two showed potency and the third non-potency ; while of those vaccines mixed with strengths of hydrochloric acid above ·75 per cent., every one was non-potent. Thus ·5 per cent. watery solution of hydrochloric acid seems to be the limit of acidity that can be used in this way with safety to the specific organism. Of the sodium carbonate solutions on the other hand, the borderline of alkalinity at which the specific organisms may or may not be rendered inactive, seems to be 2 per cent. ; for in the three experiments in which this strength of solution was used, two gave vesicles after inoculation, while the third was not followed by vesiculation. The 1·75 per cent. solution and all lesser strengths were used on vaccines with safety to the specific organisms, and the 2·25 per cent. and 2·5 per cent. solutions each rendered the specific organisms of their respective vaccines non-potent by the fourteenth day after admixture.

There was a noticable difference, however, at the sites of inoculation on the calves 120 hours after vaccination between

Table A.

I.—*Hydrochloric Acid* (HCl).

No. of Experiment.	Strength of Solution.	No. of Colonies of Extraneous Organisms. At Mixing.	At end of 1st week. Experiment.	At end of 1st week. Control.	Potency at end of 2nd week. Potent.	Potency at end of 2nd week. Non-potent.
	Per cent.					
1	0·50	890	27	4,600	Potent.	..
2	0·50	901	312	580	„	—
3	0·50	76,000	123	11,200	„	—
4	0·75	11,000	2,080	1,155	—	Non-potent.
5	0·75	76,000	24	11,200	Potent.	—
6	0·75	901	11	580	„	—
7	1·00	76,000	0	11,200	—	Non-potent.
8	1·00	11,000	1,900	1,155	—	„
9	1·00	901	54	580	—	„
10	1·25	76,000	0	11,200	—	„
11	1·25	11,000	320	1,155	—	„
12	1·25	901	0	580	—	„
13	1·50	76,000	0	11,200	—	„
14	2·00	1,960	0	45	—	„

II.—*Sodium Carbonate* (Na_2CO_3).

1	0·50	890	963	4,600	Potent.	—
2	0·75	11,000	21,000	1,155	„	—
3	1·00	76,000	2,000	11,200	„	—
4	1·00	11,000	60,000	1,155	„	—
5	1·25	11,000	62,000	1,155	„	—
6	1·25	901	1,800	580	„	—
7	1·50	76 000	1,786	11,200	„	—
8	1·50	901	12,000	580	„	—
9	1·75	76,000	1,250	11,200	„	—
10	1·75	901	7,000	580	„	—
11	2·00	901	4,000	580	„	—
12	2·00	1,960	203	45	—	Non-potent.
13	2·30	76,000	4,000	11,200	Potent.	—
14	2·25	76,000	106	11,200	—	Non-potent.
15	2·50	76,000	972	11 200	—	„

those inoculated with the higher strength of acid and those inoculated with the higher strength of alkaline vaccines, in that the former showed no trace of reaction whatever, the incisions being completely healed, whilst the latter showed varying degrees of inflammatory thickening and redness along the lines of incision, though no vesiculation, suggesting that some traces of activity still remained in these vaccines. No such effect as that just mentioned followed inoculations of a calf with 2·25 per cent. and 2·5 per cent. watery solutions of sodium carbonate alone unmixed with vaccine.

The extraneous organisms, as Table A shows, were reduced in numbers in the presence of the acid solution to a certain extent. This reduction was, however, erratic. In the alkaline vaccines a larger number of extraneous organisms was trequeutly observed a fortnight after mixing than was found to be present originally. This increase, however, was not constant, and included only one, or at most two, varieties of micro-organisms. In some cases the numbers were markedly reduced.

The general result shown therefore is that calf vaccine is more tolerant of an inorganic alkaline (sodium carbonate) than of an inorganic acid (hydrochloric acid) solution, in that its specific organisms retain their potency after admixture with the former in a solution of more than twice the strength they can withstand of the latter.

CLASS B.—*Disinfectant Salts.*

This group consists of disinfectant salts. Their variety, strength of solution, and general effects on the vaccine organisms are shown in Table B. These vaccines were mixed in the proportion of one part by weight of vesicular material and four times that weight of solution.

Sodium biborate is the one member of this group giving striking results. Four experiments were made with it; in the first of these a 3·5 per cent. watery solution was employed, and in the remaining three cases a saturated watery solution of the salt. The most noteworthy feature is that the vaccines, mixed with these solutions, retained their potency for a considerable time, in spite of the very rapid and marked germicidal effect exerted by the salt on the extraneous organisms. The activity of the specific virus seemed indeed in no way injured, for two of the series were potent at the end of three months after they were mixed, their inoculations on calves being followed by vesicles of very good quality. The first of these four vaccines was found to be inactive when inoculated seven months after it was mixed, but so was its control; and this is not surprising considering the poor quality of the vesicles from which it was collected.

In the first three experiments noted in Table B, the vaccine contained extraneous organisms considerably in excess of the average number; the fourth vaccine contained approximately an average number. At the end of the first week after mixture,

Control.		
end of	Potent.	Non-Potent.
month	Potent	—
month	Potent	—
months	Potent	—
months	Potent	—
months	Potent	—
weeks	Potent	—
weeks	Potent	—
weeks	Potent	—
weeks	Potent	—
weeks	Potent	—

however, each, even of the first three vaccines, contained far fewer extraneous bacteria than their respective glycerine controls, while at most, the time required for the complete elimination of extraneous bacteria in each of the four experimental vaccines was half that necessary to obtain a corresponding result in the controls.

Altogether one may say that biborate of soda as a germicide for the preparation of vaccine has, in this number of experiments, given good results.

A fifth experiment with this substance was discarded, and is consequently not entered in Table B owing to the occurrence of *bacillus mesentericus* in it; this organism persisted in both the experimental vaccine and its control, obscuring the growth of the other organisms on the agar-agar plates. Thus, biborate of soda exerted no stronger effect on this spore-bearing organism than did glycerine.

Of the remaining six bodies in this group—perchloride of mercury, potash alum, permanganate of potash, sodium sulphate, salicylate of soda, and quinine hydrochlorate—each, with the exception of permanganate of potash, showed a certain amount of germicidal action on the extraneous micro-organisms, though not so strong an action as that of glycerine on the controls, and apparently was quite innocuous as regards the specific virulence. The one exception, permanganate of potash, was tried but once, therefore too much stress must not be laid on the result. Generally the vesicles yielded by the foregoing six vaccines were of poorer quality than those following the inoculation of their controls. For this reason, the further use of these substances was not continued.

CLASS C.—*Disinfectant and other Substances.*

This class contains eleven substances which give the results noted in Table C. One part by weight of vaccine was added to four times that weight of solution, except in the cases of paraffin and toluol.

Of the eleven substances noted in the table, more than one is deserving of individual notice. These are :—

Boracic Acid.—One experiment only has been made with this substance so far, and in this a saturated watery solution of the substance was used. The vaccine became free from extraneous organisms at the end of the third week, and was potent for vaccination at the end of three months from the date of mixing. The control, on the other hand, was not free from extraneous organisms until the end of the seventh week after mixing. Boracic acid showed an action similar to that of biborate of soda in Class B.

Carbolic Acid.—This was first used in solution in distilled water in a strength of 1–500, and this solution proved useless as a

germicide. Afterwards it was employed, also in solution in distilled water, in strength of 1–200, 1–100, and 1–50, and in the case of the weakest of the solutions the vaccine was freed from extraneous organisms in 24 hours, while the three remaining vaccines were freed from extraneous organisms, two in twenty-four hours and one in one week. All these vaccines gave good vesicles after inoculation on calves from a week to a month from the time of mixing. Carbolic acid in watery solutions had the most rapid germicidal action of any substance experimented with up to this point while allowing at the same time the specific organisms to retain their activity. When these vaccines were free from extraneous bacteria, the controls still contained many such organisms and indeed were not free from them until the end of a month to six weeks after mixing.

Carbolic Acid and Glycerine.—Four experiments were made with carbolic acid in solution in glycerine in strength of 1–50, 1–100, 1–200; and in all four cases the vaccine gave no cultivations of extraneous organisms on agar-agar plates at the end of the first week. When subsequently tested for potency two of these vaccines were active at the end of the first week and two at the end of one month from the date of mixing, but in all cases the resulting vesicles were not of such a good character as those of the respective controls.

These vaccines, compared with those mixed with carbolic acid in solution in water, showed rather slower progress in the elimination of extraneous bacteria, though in all cases the progress was much more rapid than in the case of the glycerinated controls which were not freed from extraneous germs until the end of four to six weeks from the time of mixing.

Lysol.—This substance was used in one experiment and had a germicidal action, stronger in the first week and less strong afterwards than the glycerine in the control. The experimental vaccine was potent at the end of three months. On the whole, it seems probable that a stronger solution of lysol than 1–500 might be safely employed in similar experiments.

Formalin.—In two experiments, in strengths of 1–200 and 1–1,000 in distilled water respectively, this substance was germicidal to the specific as well as to the non-specific organisms of vaccine in seven days. In the strength of 1–10,000 in distilled water, however, while the extraneous organisms were killed at the end of one week, the specific organisms were alive, though but poor vesicles followed the inoculation of a calf with the vaccine.

Paraffin.—This was liquid paraffin of the kind used for illuminating purposes, and frequently also for cleaning woodwork and fittings in laboratories. Crude vaccine pounded in a mortar with this substance will not form a fluid mixture but a sticky mass, which is probably dehydrated to a certain extent by the paraffin. In these experiments the vaccine was pounded with

Control.		
d of	Potent.	Non-potent.
ıths	Potent	—
nth	Potent	—
›ek	Potent	—
nth	Potent	—
eks	Potent	-
›ek	Potent	—
nth	Potent	—
›ek	Potent	-
nth	Potent	—
›ek	Potent	—
eks	Potent	—
eks	Potent	—
ıths	Potent	—
ıths	Potent	—
ıths	Potent	—
ıths	Potent	—
eek	Potent	—
eek	Potent	—
eks	Potent	—
ıths	Potent	—
eks	Potent	—
eks	Potent	—

paraffin until such a mass was formed; this was inserted into a stock tube and the stock tube was then filled with paraffin, corked and sealed. So far from having a germicidal action on the extraneous organisms, these had increased to treble or more their original number at the end of the first week, and a progressive increase was maintained afterwards. The specific organisms lived during this process, for inoculations of the two vaccines on a calf at the end of four and five months respectively, from the date of mixing, were followed by well formed vesicles.

The remaining five substances of this group—iodine, iodine and iodide of potassium (Gram's solution), ethyl alcohol, toluol, and ether—eliminated the extraneous bacteria of their respective vaccines in varying degrees of rapidity, and all in their higher strengths more quickly than the glycerine of their controls. But also they destroyed the potency of the specific organisms, in some cases in very short periods of time.

The specific virus then presents but little difference from the extraneous organisms in resistance to the action of these last five substances.

CLASS D.—*Carbohydrates.*

The first substance of this group experimented with was a sugar —dextrose. This is the first experiment noted in Table D. The vaccine prepared with a solution of this sugar showed such a decided lessening of extraneous organisms at the end of the first week after mixing, and subsequently, with retained vitality of specific germs, that a series of experiments was begun with this and other carbohydrates which could be obtained commercially. These were three glucoses—dextrose, levulose, and galactose; four saccharoses—cane sugar, lactose, maltose, and raffinose; and four amyloses—starch, glycogen, dextrine and saccharine.

These were employed in the strength of saturated watery solutions; one part by weight of vaccine pulp was mixed with four times that weight of solution in each case.

The Glucoses.—The three glucoses acted on the whole in a very uniform way. They showed a marked germicidal action on the extraneous bacteria of their respective vaccines, and this property was most strongly marked perhaps with dextrose in the first experiment noted in Table D, where there were originally present 30,000 extraneous micro-organisms per loopful of vaccine. At the end of the first week this number had diminished to 2,400 per loopful of experimental vaccine, and to 2,060 per loopful of the control, while the total elimination of these organisms occurred at the end of eight weeks in the experimental vaccine, and at the end of seven weeks in the control. In the remaining two experiments with dextrose, in the two with levulose, and in the one experiment with galactose, a similar germicidal action

was manifested, the glycerine of the controls having a rather more rapid action in each case. There seems to have been no harmful action exerted on the specific organisms of the vaccines by these substances, for good vesicles followed inoculation of the vaccines in all cases from two to eight weeks after mixing.

The Saccharoses.—These substances, with two exceptions, closely followed the action of the glucoses both as regards germicidal action on extraneous organisms and absence of any ill effect on specific germs. Two important exceptions, however, occurred in lactose and maltose. In four experiments with lactose and one with maltose there appeared to be not only an absence of germicidal action on the extraneous micro-organisms of the vaccines, but on the contrary there was a marked tendency for the solutions of the two sugars to act as nutrients, whereby the extraneous micro-organisms increased greatly in number, especially in two of the experiments with lactose. In none of these cases, however, was any injury of specific germs apparent, for inoculations of the vaccines on calves, in some cases at the end of three or four months after mixing, were followed by good vesicles, though these were not of better quality than the vesicles yielded by the controls.

The Amyloses.—Of these glycogen and dextrine, in two experiments each, showed actions strongly resembling those of the glucoses, and of cane sugar and raffinose in the saccharose series, in their germicidal powers on extraneous organisms, and in their apparent inability to affect injuriously the specific germs. Starch on the other hand resembled somewhat the actions of lactose and maltose in that it showed no deleterious action on the specific germs, and allowed an increase in extraneous organisms. Saccharine in the two experiments made with it, showed the strongest germicidal action of any of this series of carbo-hydrates, for in each of the experiments the extraneous bacteria disappeared more quickly than in the case of either of the glycerine controls, and in spite of this the specific organisms were apparently not harmed, judging from the good quality of the vesicles following inoculations of the vaccines four and five weeks after they were mixed with their solutions.

The majority therefore, of these carbo-hydrates have shown interesting characteristics in their germicidal action on the organisms of crude calf vaccine. Why sugars, as in the instance of dextrose and lactose, should possess such diametrically opposed germicidal characteristics, it is difficult to say. No fermentation or any other sign of decomposition was noticed in any vaccine of this carbohydrate series.

CLASS E.—*Chloroform.*

This substance might have been included in one or other of the foregoing groups. But the results obtained by its use have been exceptional, and it will be advantageous to consider its action

	Control.	
of	Potent.	Non-potent.
ıs	Potent	—
s	Potent	—
s	Potent	—
s	Potent	—
s	Potent	—
s	Potent	—
s	Potent	—
s	Potent	-
s	Potent	—
s	Potent	—
s	Potent	—
ls	Potent	—
s	Potent	—
s	Potent	—
s	Potent	—
	—	—
s	Potent	—
s	Potent	—
s	Potent	—
ı	Potent	—
ı	Potent	—
ı	Potent	—
ı	Potent	—

separately. It has been used in various ways, the first of which was admixture, in various proportions, of vaccine pulp with sterile distilled water saturated with chloroform.

I.—Admixture of Vaccine Pulp with Sterile Distilled Water Saturated with Chloroform.

A slight modification of method in mixing was adopted in this preparation of vaccine owing to the extreme volatility of chloroform, whether in its pure state or in saturated watery solution. The modified procedure was as follows :—

A stock bottle of chloroform water was kept for use, prepared in the following way; that is to say pure chloroform, specific gravity 1·490, was poured into a clean sterile glass bottle of one half litre capacity to the depth of about one inch, and sterile distilled water was added so as to nearly fill the bottle. The whole was then shaken, and half an hour later was considered ready for use, the minute droplets of chloroform having by that time separated from the water, so that all excess of chloroform rested at the bottom of the bottle. By retaining this excess in the bottle, the constant saturation of the water with chloroform was assured, such saturation being 1 part of chloroform in 200 parts of distilled water.

A weighed quantity of crude calf vaccine was passed through Dr. Blaxall's modification of the Chalybäus machine, by which process it was very finely ground into a soft homogeneous mass. This ground up pulp was then placed in a sterile mortar, and the amount of chloroform water to be added was determined *by volume*. In the preliminary mixing of vaccine and chloroform water in the mortar, only half the total quantity of chloroform water to be used for the experiment was taken, the remainder being added later. I found it most convenient to retain, for use as required, the first half of the quantity of solution in the graduated pipette in which it was measured; for this pipette if laid horizontally on the top of a glass beaker, or on some convenient piece of apparatus on the bench, allowed of a minimum amount of evaporation of chloroform from the solution owing to the small area of fluid exposed to the air, and at the same time it was conveniently placed for use, for by slightly tilting up the suction end of the pipette from time to time, a few drops of solution easily dropped from the nozzle into the mortar containing the vaccine. This ground up vaccine was continually stirred with the pestle, five or six drops of chloroform water being added to it at a time until an intimately mixed semi-fluid substance was obtained. Any chloroform water remaining in the pipette was then added in bulk, quickly stirred up, and the resulting mixture was poured into stock tubes, each stock tube being filled to $\frac{1}{2}$, $\frac{3}{5}$, or $\frac{4}{7}$ of its capacity according to the different proportions

of vaccine and solutions to be used. The capacity was previously estimated with the cork *in situ* in the tube, and the estimated depth marked on the tube with a grease pencil, together with the level occupied by the cork inside the tube. The remaining space of each stock tube was filled up with chloroform water directly from the stock bottle and the tube was then rapidly corked and sealed. Especial care was taken to leave no air space between the top of the column of fluid and the bottom of the cork. Finally each tube was shaken for one or two minutes, after which the contents appeared homogeneous.

This method may seem less accurate than that used for non-volatile bodies, but with a very little experience of its use the process becomes almost if not quite as exact as if the required amount of fluid were weighed. For with the most careful weighing some amount of variation from the exact proportions must occur in a final mixture of vaccine pulp and solution owing to the varying amount of moisture present in vaccines at the time of their collection. This amount of moisture varies considerably. Moreover, the foregoing method of mixing chloroform water and vaccine has the all important advantage in ensuring the presence of chloroform in the finally added solution in its full strength of saturation.

Until all the extraneous micro-organisms were killed the stock tubes of these vaccines were only disturbed to momentarily remove the corks for the purpose of making the necessary plate cultivations. In the case of several of the series, when the vaccines no longer showed any growth of extraneous organisms, it was desired to get rid of the chloroform, and leave the vaccine in the presence of distilled water only. For this purpose the stock tubes of vaccine were placed uncorked in large test tubes kept in a vertical position and with the mouth of each test tube lightly plugged with cotton wool; the whole proceeding was carried out under aseptic precautions. The vaccines were kept thus from one to two days, and at the end of this time it was found by means of various tests, more notably by treating vaccine with a primary amine and an alcoholic solution of caustic potash, that all trace of chloroform had disappeared from them. This was an easy way of completely freeing the vaccines from the presence of the germicide when its work had been done, in order to prolong the vitality of the specific germs for as long a period as possible.

Table E gives the various details of these experiments with vaccine and chloroform water.

As shown in this table 19 experiments were made by the method just described, with the result that though several of the vaccines originally contained extraneous organisms in numbers considerably above the average for crude calf vaccine, yet no vaccine showed any extraneous growth on plate cultivation after the eighth day after it was mixed, while the majority of vaccines showed no growth on the seventh day, and may possibly have been free from extraneous organisms even earlier, for in four cases where cultivations were made 24 *hours after the vaccine were*

I.		No. of Experiment.
.	Non-potent.	
t	—	1
t	—	2
t	—	3
t	—	4
t	—	5
t	—	6
t	—	7
t	—	8
t	—	9
	Non-potent	10
	Non-potent	11
	Non-potent	12
t	—	13
	Non-potent	14
	Non-potent	15
	Non-potent	16
t	—	17
t	—	18
t	—	19

mixed no growth appeared on the agar-agar plates. In all the controls extraneous growth appeared at least up to the end of the fourth week, and in some cases up to the end of the sixth or eighth week. In every case these cultivations were made from a platinum loopful of vaccine, but in two of the experiments, Nos. 17 and 19, cultivations were also made from a capillary tubeful of vaccine, at the end of the first week, and 24 hours after mixing, respectively, and in each case no extraneous organisms were present. Mr. H. S. Fremlin kindly poured the plates of the former of these two vaccines at my request.

The potency of these vaccines prepared with chloroform water has, I think, been very satisfactory; many of the series were potent at the end of five and six months, and in one case at the end of seven months from the date of mixing, while the character of the vesicles yielded after inoculations of calves has been almost uniformly good. In no case did a vaccine show a shorter period of potency than its control; but on the contrary, six controls failed to show any sign of vesiculation after inoculation on a calf when the corresponding experimental vaccines gave well-marked vesicles, though not vesicles of first-rate quality.

Further experiments are necessary to show the optimum quantity of chloroform water to add to vaccine in proportion to its weight. In cases where it is required to free a vaccine from its extraneous organisms in 24 hours, probably it would be better to add five or six times the weight of chloroform water in proportion to the weight of vaccine; and this proportion does not seem to be inconsistent with duration of potency, for two vaccines so prepared were potent at the end of five months. Should, however, it be found that for duration of potency of a vaccine four times its weight of chloroform water is better, the excess of fluid could be poured away from a vaccine as soon as it was free from extraneous bacteria.

In order to demonstrate this chloroform water method more minutely, vaccine pulp was taken at random and mixed by the foregoing method with four times its weight of chloroform water (experiment No. 14, Table E). This vaccine originally showed 195,000 colonies of extraneous micro-organisms per platinum loopful, and subsequent plate cultivations were made at the end of 24 hours, and on the 3rd, 5th, 7th, and 14th days, the stock tube being opened momentarily only for the platinum loop to be filled with vaccine, after which it was immediately re-corked and re-sealed. Plate cultivations of the control were made at the end of the first and every subsequent week up to the seventh, when no growth of extraneous organisms appeared. The results of these various cultivations are shown in the following scheme:—

SCHEME OF EXPERIMENT NO. 14 IN TABLE E.

Number of Colonies of extraneous Organisms at Mixing Vaccine:—195,000.

At end of	Number of Colonies of Extraneous Organisms.	
	Experimental Vaccine.	Glycerine Control.
24 hours... ...	5,200	—
3rd day	321	–
5th day	47	—
7th day	0	17,300
2nd week ...	0	1,169
3rd week ...	—	231
4th week ...	—	162
5th week .	—	33
6th week ...	—	19
7th week ...	—	0

Thus this vaccine, which was collected from very poor quality vesicles, and which contained by far the greatest number of extraneous organisms of any vaccine of this series, was freed from them at the end of the seventh day after it had been mixed with chloroform water, while its glycerine control did not become free from extraneous organisms until the end of the seventh week.

The potency of this experimental vaccine was repeatedly demonstrated by vesicles following its inoculation on calves, and subsequently it was used for the vaccination of children. Three weeks after the vaccine had been mixed with chloroform water two children were vaccinated in five insertions each with the vaccine. On the eighth day following, good sized well developed vesicles were seen at the site of each insertion. The vesicles and areolae were quite normal in appearance in each instance.

Five weeks from the date of mixing, five children were vaccinated in five insertions each with this vaccine, and on the eighth day following four of the children showed five vesicles each, while the fifth child had only three vesicles. The vesicles and areolae were quite normal.

Well developed vesicles followed the inoculation of this vaccine on several occasions on which it was inoculated on calves. On the last occasion, five months from the date of mixing, moderate vesicles only resulted. At the same date, however, the glycerine control was no longer potent.

II.—Admixture of Vaccine, Glycerine, and Distilled Water saturated with Chloroform.

This is the second way in which chloroform has been used in these experiments. It seemed doubtful at the outset whether any germicidal action quicker than that of glycerine would be induced by this method, as chloroform and pure glycerine will not mix. A quicker germicidal action, however, was found to occur.

The procedure adopted in this case was to take a weighed portion of vaccine that had been ground up in the special machine before mentioned. This ground up vesicular material was intimately mixed by means of a pestle and mortar, with twice its own weight of glycerino, and stock tubes were filled with the mixture to $\frac{1}{4}$, $\frac{2}{5}$, or $\frac{1}{2}$ of their capacity, which was previously estimated with the cork *in situ*, and this distance marked on the tube with a grease pencil, together with the level occupied by the cork inside the tube. The remaining space in the tube was filled with chloroform water directly from the stock bottle, and each tube was corked and sealed immediately.

Table F gives the details of the experiments, sevenin number.

It will be seen from this Table that the longest time occupied in destroying the extraneous organisms of any vaccine was 15 days, and the shortest time one week. Thus the germicidal action of chloroform water and glycerine was found to be more prolonged than the action of chloroform water alone on the extraneous micro-organisms of crude vaccine. But on the other hand it was much quicker than the action of a 50 per cent. solution of glycerine and water, for none of the controls of these vaccines were free from extraneous bacteria before the end of the 5th, 6th or 8th week after mixing. It should also be noted that none of these experimental vaccines were tested for extraneous organisms earlier than the end of the first week after mixture, and their germicidal action may have been quicker than is noted in Table F.

The potency of these seven experimental vaccines is, I think, able to bear comparison with those prepared with chloroform water alone, for good vesicles were obtained by inoculating calves with them, five, six and seven months after they were mixed. No vaccine of the series, however, showed potency after its control had become inactive, differing in this respect from five vaccines prepared with chloroform water alone.

TABLE F.

Chloroform ($CHCl_3$) (saturated in distilled water), *and Glycerine.*

No. of Experiment.	No. of Colonies of Extraneous Organisms.					Free from Extraneous Organisms.		Potency.					
	At Mixing.	Experiment.		Control.		Experiment.	Control.	Experiment.			Control.		
		At end of	No.	At end of	No.	At end of	At end of	At end of	Potent.	Non-Potent.	At end of	Potent.	Non-Potent.
1	7,000	1 week	0	1 week	980	1 week	5 weeks	7 months	Potent	—	7 months	Potent	—
2	6,100	1 week	0	1 week	943	1 week	—	6 months	Potent	—	6 months	Potent	—
3	7,100	1 week	1	1 week	987	—	—	2 months	Potent	—	2 months	Potent	—
4	11,300	1 week	34	1 week	1,900	10 days	6 weeks	2 months	Potent	—	2 months	Potent	—
5	91,000	1 week	26	1 week	4,600	10 days	8 weeks	2 months	Potent	—	2 months	Potent	—
6	7,850	1 week	1	1 week	1,160	—	—	2 months	Potent	—	2 months	Potent	—
7	79,000	1 week	86	1 week	4,060	15 days	—	5 months	Potent	—	5 months	Potent	—

III.—Vaccine and Pure Chloroform.

Three experiments have been made with vaccine and pure chloroform. The two substances do not form a fluid mixture, consequently the vaccine was merely placed in a stock tube which was then filled up with chloroform. In the three experiments, while no growth of adventitious organisms occurred 24 hours after mixing on agar-agar plates; in only one case did a possible vesicle follow the inoculation of a calf with the preparation, one week after mixing. No trace of vesiculation was seen in the case of the other two.

Experiments are being made by adding a few drops of pure chloroform to stock tubes of vaccine, prepared by the chloroform methods I. and II.

Conclusions.

A striking circumstance becomes evident in a series of these experiments as they are noted in detail in the various tables, namely that the specific vaccine virus can withstand the action of several substances besides glycerine, which kill in part or wholly the extraneous organisms; in other words, that these substances appear to have a "selective" germicidal action on the micro-organisms of crude calf vaccine. While the great majority of substances experimented with have shown this property—and not the least interesting are several members of the carbohydrate group—a careful consideration of the whole of the experiments shows that four substances in particular are of great interest on account of their strong selective germicidal qualities compared with glycerine. These substances in the order in which they appear in this paper are (i.) sodium biborate, (ii.) boracic acid, (iii.) carbolic acid, (iv.) chloroform, and possibly a fifth, saccharine. From these four or five substances, chloroform stands out conspicuously when employed as a saturated watery solution, and also when used in the same solution with the addition of glycerine. Under the action of these solutions of chloroform, I have found that the extraneous micro-organisms of crude calf vaccine have been, as a rule, eliminated in from 24 hours to seven days, while the specific organisms have survived in every case as long as the specific organisms in the glycerine controls, and in six cases for a longer period than in those controls. In the case of a watery solution of chloroform, one is enabled to do what would be impossible in the case of a non-volatile substance, namely, to allow the germicide (chloroform) to evaporate from the vaccine under aseptic precautions when once all the extraneous bacteria have been killed, and thus to preserve the purified vaccine in the presence of a small or moderate amount of sterile distilled water.

So far chloroform has been used in only 20 to 30 experiments, but it would seem well worth while to continue these observations, for, should a larger number substantiate the results I have already obtained, the use of chloroform in the preparation of vaccine would prove of considerable value.

THE EFFECT OF DESICCATION ON CALF LYMPH;

By Dr. F. R. BLAXALL.

Vesicles were collected from a calf 120 hours after vaccination, and the weight ascertained. The vesicular material was then transferred to a sterile porcelain dish and dried over sulphuric acid *in vacuo*. The vacuum was obtained by means of a Fleuss pump. After 24 to 48 hours of this treatment the lymph was found to be quite dry, and was then powdered in a sterilised glass mortar. Lest during this process moisture should have been absorbed from the atmosphere, the powdered lymph was subjected to a second drying. It was then weighed, and the loss of weight during the process of desiccation ascertained. The lymph powder was stored in small glass tubes, hermetically sealed. It was subjected to two tests; first, as to whether the dried lymph retained its vaccinating properties; and, secondly, as to the effect of desiccation on the extraneous organisms.

Loss of Weight.—The difference between the weights of the fresh vesicular material and the dried powder was found to be considerable and is recorded in Table I.

Vaccinating properties.—Trial was made on calves of the dried lymph in three ways, first by putting in a little of the powder into incisions of the skin, secondly by mixing some of the powder with a little distilled water and inoculating incisions with this mixture, and thirdly by inoculating the incisions with a mixture of the powder and glycerine. These three methods of application gave equally good results.

Up to the present, vesicles have been collected from four calves and dried separately. These dried lymphs have been under observation now for five months in three instances, and four months in one, and have yielded good vesicles when trial was made on calves after lapse of these intervals. It may be said of these lymphs that two at least were not of such quality when collected from calves as to suggest that under the ordinary circumstances of glycerination their potency would have been retained for so long a time.

Extraneous organisms.—Immediately after the drying of the vesicular material, a platinum loopful of the powder was withdrawn and agar plates were established and incubated in the usual way. It was found that a considerable number of colonies developed on the plates. The average number of colonies obtained in this way from the powders was 2,857. The organisms were those habitually met with in glycerinated calf lymph and consisted almost entirely of staphylococci, albus and aureus. It was not practicable to institute a comparison between the number

of extraneous organisms present in the lymph before and after desiccation owing to the difficulty of examining equal quantities; nor is it a matter of much importance, though taking into consideration the great uncertainty in yield of the material after desiccation it may be inferred that a considerable number of organisms were actually eliminated in the process of drying.

Further examinations of the extraneous organisms present in the powders were carried out from time to time and showed that they were dying out slowly, though up till five months the elimination in no case had been complete.

In one instance, Experiment 3, Tables I. and II., Dr. Green, who most kindly has carried out the major portion of this work for me, has subjected the powder to the influence of chloroform vapour to ascertain whether by these means the extermination of the extraneous organisms might be hastened. The results obtained as well as those of the periodical examinations are set forth in the following Tables I. and II.

TABLE I.

No. of Experiment.	Weight of Pulp in grammes.	Weight of Dried Pulp in grammes.	Differences in Weight.	Result on Calves.
1	12·0	3·5	8·5	Good vesicles 5 months after drying.
2	15·8	5·1	10·7	" " "
3	3·0	1·1	1 9	" " "
4	5·4	1·9	3·5	Good vesicles 4 months after drying.

TABLE II.

No. of Experiment.	No. of Colonies.			
	At Drying.	At end of 1st week.	At end of 4th week.	At end of 20th week.
1	1,169	1,209	1,340	107
2	3,000	590	780	113
3	4,100	460	490	70
4	3,100	1,400	686	148

Thus the experiments show that the vaccine organism can withstand desiccation for as long a period as four months without loss

of vitality, and that in this respect it appears to possess greater resistance power than the majority of the extraneous organisms. At the same time the fact that these organisms gradually diminish in numbers as time proceeds, argues that the destructive action of desiccation is not limited to its actual production, but has a sequential and far-reaching effect, and therefore it cannot but be expected that this eliminating influence will in the course of time extend to the vaccine organism itself and be made manifest by loss of potency. So far, however, no deterioration in the virulence of the vaccine organism has been apparent, and it remains for the continuation and extension of these experiments to define, if possible, the limitations of such resistance.

This work was projected in the first instance because it was thought that, besides being of considerable scientific interest, the subject might yield some results capable of a practical application. Experience has led me to believe, that other things being equal, the chief inimical influence to glycerinated calf lymph is exposure to variation in temperature ; and further, there was evidence to show that the effect of such variation in temperature was largely dependent upon the presence of moisture ; in other words, in the presence of moisture associated with warmth approaching blood heat temperature, the organisms contained in glycerinated calf lymph commence to grow, and in this young condition, glycerine appears to be very fatal to them. From this it is by no means necessary to assume that the vaccine organism, any more than the majority of the extraneous organisms, exists in a sporing condition. The case is met by supposing that the organisms in glycerinated calf lymph when kept at a cool even temperature remain quiescent and make no attempt to grow ; but directly the temperature rises into the neighbourhood of blood heat, growth commences, and is generally attended with fatal results. New growth cannot take place without the presence of moisture, and hence it was thought that desiccation of the lymph might remove one source of danger, and that in this dry state the vaccine organism might be much less amenable to variation in temperature. If such were proved to be the case, a method of storing lymph might be found, very economical in space, and (a most important matter) practically independent, not only of seasonal variations of temperature, but also of such climatic variations as prevail in the tropics, and in this way storage and transmission of lymph might be accomplished in hot countries with diminished risk. These points are the subjects of experimental enquiries, and will be dealt with in future papers.

THE EFFECT OF RÖNTGEN RAYS ON GLYCERINATED CALF LYMPH;

By Dr. F. R. Blaxall.

The Röntgen rays were obtained by the passage through Crooke's tubes of a current derived from a static machine (Pidgeon's pattern). The static machine was worked from an electric motor. Some difficulty was experienced in obtaining a continuous glow for a considerable time owing to imperfections in the machine. The time of exposure to the rays was 12 hours spread over three days, the exposure on each day being about four hours. Freshly prepared glycerinated calf lymph in capillary tubes was placed within the focus of the Crooke's tube, one sample being placed in a wooden box to permit the passage of the rays, another sample being placed in a metal box through which the rays could not penetrate to serve as a control. So that the two samples were the whole time of the experiment in precisely similar conditions, save that the one sample was under the influence of the Röntgen rays, the other was not. Immediately before and after the exposure the number of extraneous organisms present in the two samples of lymph of each experiment was estimated by establishing agar plates from the lymphs in the usual way. These plates were incubated in the usual manner, and the colonies that developed on them enumerated. The experiment was performed five times, and the results are given in the following table :—

Series.	No. of Colonies.			Result on Calves.	
	At Mixing.	Tubes in Wooden Box after Exposure to Röntgen Rays.	Control Tubes in Metal Box.	Tubes from Wooden Box.	Control Tubes from Metal Box.
595	15,000	1,933	1,966	Good	Good
1,027	3,100	2,200	2,100	"	"
1,028	60,000	48,000	47,000	"	"
1,029	72,000	24,000	16,200	"	"
1,030	25,200	24,300	25,800	"	"

From this it will be seen that the Röntgen rays caused no appreciable diminution of the contained micro-organisms. After exposure, the exposed lymphs and control lymphs were tested on calves and yielded equally good vesicles in each instance.

Subsequently these lymphs were used for the vaccination of children with complete success in each instance. Thus, these experiments show that Röntgen rays obtained in this way and acting for this period of time (12 hours) have no practical action on glycerinated calf lymph either in regard to its potency or in regard to the contained extraneous organisms.

SOME OBSERVATIONS ON THE BLOOD OF CALVES BEFORE AND AFTER VACCINATION;

By Dr. ALAN B. GREEN.

It is a well-known fact in vaccination establishments that when several calves of a batch are inoculated with the same strain of vaccine at the same time, the response to that vaccination will show great variation. Some calves may yield vesicles of first-rate quality, while others may fail entirely or show but an indifferent crop of vesicles; and between these extremes all gradations may be seen.

The strain of vaccine being the same, and the operation being performed on each calf in the same way, this difference in result must depend upon the calf and upon the "condition" of the calf; and, indeed, it is a matter of common observation that calves out of "condition," though not necessarily in any marked degree, nearly always fail to respond properly to vaccination.

It was thought that a study of the blood of calves might possibly throw some light upon this variation, and that in any case the subject was likely to be one of much interest. Endeavours were made to obtain literature dealing with the histology of the blood of calves, but without success. Consequently, it was necessary in the first instance to study normal calves' blood, and a series of experiments and examinations was instituted :—

(*a*) To study calves' blood before vaccination, and to compare it with a similar study of their blood after vaccination.

(*b*) To ascertain whether any variations which might obtain in the blood, either before or after vaccination, would show, in the first place, any relation to the health and general condition of the calf; and, in the second place, to the quality of the vesicles yielded by the calf.

(*c*) To ascertain whether the process of vaccination be accompanied by any material change as indicated by alterations in the blood.

In all, 25 calves have been examined. Each calf was examined twice, the first time immediately before vaccination, the second time 120 hours after vaccination, making altogether 50 examinations. All examinations were made at the same time of day, between 11 a.m. and 12 m.

The animals were not specially selected for the purpose, but were taken by chance. As a rule two calves were examined every week. Of the 25 animals, 16 were males and 9 females. The average age was 4¾ months; maximum 8 months, minimum 2 months.

Preliminary to each examination an ear of the calf was shaved, cleansed with (*a*) 1-40 carbolic solution, (*b*) distilled water, and (*c*) absolute alcohol. When dry, a slight prick was made with a sterilised guarded needle and two or three drops of blood sufficient for the examination were easily obtained without applying pressure to vessels.

The following are the methods and results of the examinations of the blood made before and after vaccination.

Specific Gravity before Vaccination.

Hammerschlag's chloroform-benzole method was used. The average specific gravity of the blood of the 25 calves was found to be 1054 ; the highest specific gravity of the series was 1061, the lowest 1045. Eliminating the few extreme cases most likely due to diarrhœa, the normal specific gravity may be taken to lie between 1052 and 1056.

Specific Gravity after Vaccination.

The average specific gravity was found to be 1,052 ; maximum 1,069, minimum 1,032·5.

In nine cases the specific gravity before vaccination did not differ by more than a degree from that after vaccination. Cases of much variation could practically always be accounted for by diarrhœa.

Number of Red Corpuscles before Vaccination.

The red corpuscles were in all cases estimated by the Thoma-Zeiss hæmacytometer.

The average number of red cells was found to be 9,500,000 per cubic millimetre ; maximum 10,336,000, and minimum 8,232,000.

Number of Red Corpuscles after Vaccination.

The average number of red cells was found to be 9,100,000 ; maximum 10,600,000, minimum 8,700,000, showing very little difference from the series taken before vaccination ; nor did any individual cases of the two series exhibit any marked difference.

Actual number of White Corpuscles before Vaccination.

The white corpuscles were in all cases estimated by the Thoma-Zeiss "white counter." The average was found to be 15,000 white cells per cubic millimetre, but the variation between the numbers found in one animal and another was considerable ; maximum 23,300, minimum 8,800.

Actual number of White Corpuscles after Vaccination.

The average number was found to be 16,000 per cubic millimetre; maximum 26,500, minimum 11,000. This showed an average increase of white cells after vaccination; an increase which was practically constant throughout the series, being present in all but four cases.

In this connection it may be remarked that the average temperature before vaccination was found to be 102·6° F., after vaccination 103·9° F.; and that there was a rise of temperature in each case of the series after vaccination. The leucocytosis seemed to bear no special relation to this slight increase of temperature; nor did it to the age of the calf, being as marked in a calf of eight months as in one of two or three months old. In the same way it showed no special relation to any other condition of the calf apart from vaccination.

Examination of White Cells.

Films were made in the usual way on coverslips, specially prepared by boiling in acid, washing in (*a*) tap-water, (*b*) distilled water, (*c*) methylated spirit, and (*d*) absolute alcohol. The alcohol was burnt from a sufficient number of coverslips at each examination.

Compared with the preparation of human blood films, a good film of calves' blood is not easy to make, for the apparent reason that calves' blood coagulates much more rapidly, consequently the requisite minute drop will not spread so evenly, thinly and thoroughly between coverslips.

When using Jenner's stain for these films it is necessary to observe the following precautions:—Films must be recent, not more than three or four hours old, and dried in the air at room temperature. They should be stained 1½ to 2 minutes and afterwards washed in distilled water, momentarily only ("in and out"), dried immediately between folds of blotting paper, and mounted in Canada balsam. Calf-blood films so treated stain easily and well, but are not characterised by such a delicate bright appearance as the cells of human blood; and this last is perhaps due to the fact that it has been possible to wash them only for such a brief time in distilled water. The staining reaction corresponds with slight exceptions to that of human blood cells; that is, broadly stated, the nuclei are stained blue, the granules of eosine cells bright red, the granules of the polynuclear cells lighter red, basophile granules violet, and erythrocytes copper colour. The exception is due to the fact that the granules of the eosine cells to a very slight extent, and those of the polynuclear cells to a greater extent, instead of staining pure eosine-red appear eosine-red with a slight admixture of blue.

Should an old film of calves' blood be used, the granules of the polynuclear cells will take but the merest trace of eosine stain,

and even in the case of a recent film, should the foregoing precautions not be observed, the eosine will disappear more or less completely from corresponding granules when washing the film.

A week-old film of human blood and a freshly prepared film of calves' blood, stained for the same time with stain from the same bottle, and immersed for an hour in the same distilled water, show a marked difference; for the granules of the polynuclear cells of the humun blood retain perfectly the eosine colour, while those of the calves' blood almost completely lose it. Thus, this variation must be due to differences in the composition of the granules, and not to variations in the solutions employed. Furthermore, in the case of calves' blood, when one has obtained a well-stained film mounted in Canada balsam, there is a tendency occasionally for the eosine stain of the granules of the polynuclear cells to fade at the end of a few hours. The fading may be very slight or very marked. In the latter case, a blurred appearance of the granules is also often noticeable.

By passing a well-stained film twice rapidly through a Bunsen flame immediately after it is stained and dried, the eosine staining in some cases seems rendered more intense, and the granules remain distinct for a longer period than in a film not so treated. The blue of all nuclei and of the protoplasm of the hyalines and lymphocytes also appears more vivid, while the colour of the red cells is apt to be partially destroyed.

In these films of calves' blood all the varieties of white cells morphologically resembled those of human blood.

In the "Journal of Pathology and Bacteriology," December, 1900, p. 131, Dr. G. H. Scott published a method of staining blood films with Jenner's stain by a wet process, which usually gives very good results. But in calf-blood films treated by this method the granules of the polynuclear cells did not stain, while the corresponding granules of human blood were stained with eosine. On the other hand, the reaction of the granules of the eosine cells with eosine seemed to be as stable as in the case of corresponding human cells.

Treated with acids, and subsequently stained with eosine-aurantia-nigrosine, the reaction resembled that of human blood in all essential particulars, that is to say, the granules of the polynuclear cells were not dissolved, and they took a red colouration, implying that these cells were not pseudo-eosinophiles. No nigrosine staining of granules as seen in some blood cells of guinea pigs' blood was present in any of these films. With Erlich-Biondi stain, the staining resembled that of human blood cells; that is to say, the nuclei were stained pale green; the granules of the polynuclear cells, mauve; those of eosinophile cells, bright copper red; basophile cells appeared as bright colourless cells, save for their pale green nuclei; and erythrocytes were a dull copper colour. It would appear, therefore, from this reaction, that the granules of the polynuclear leucocytes are neutrophile. Indeed, the white corpuscles of calves' blood seem generally to have the same reactions as those of human blood, with the exception that with eosine-methyline-blue stain the

granules of the polynuclear cells of calves' blood have a slightly modified colour reaction with, and a much less affinity for, eosine than the granules of the corresponding cells of human blood. The term "finely granular oxyphil" for these cells would, therefore, be less correct than in the case of the corresponding human cells which were so described by Kanthack. There may also be a slight modification of colouration in the granules of the eosine-cells, as before mentioned.

With regard to the varieties of white cells which may occur in calves' blood the following are the results of my observations :—

Relative Number of White Cells.

(a) *Polynuclear Cells before Vaccination.*

These cells were found to be present in the average proportion of 37·9 per cent.

(b) *Polynuclear Cells after Vaccination.*

The average proportion was found to be 41·6 per cent., an average increase of 3·7 per cent on the number of these cells found before vaccination. This slight increase of polynuclear cells would seem to indicate that the actual increase of white cells in calves' blood after vaccination was a true though slight leucocytosis and not merely a physiological variation in the number of white cells.

(c) *Lymphocytes before Vaccination.*

The average was found to be 57·3 per cent. In staining with eosine-methyline blue stain these cells generally seemed to take a slightly deeper blue than the human lymphocytes, but histologically they closely resembled them.

(d) *Lymphocytes after Vaccination.*

The average was found to be 51·8 per cent.

(e) *Hyaline Cells before Vaccination.*

The average was found to be 3·5 per cent.

(f) *Hyaline Cells after Vaccination.*

The average was found to be 5·1 per cent.

(g) *Eosinophile Cells before Vaccination.*

The average was found to be 1·2 per cent.

The granules of these cells took an intense eosine stain, which did not fade after prolonged washing in distilled water, nor after mounting in Canada balsam.

(h) *Eosinophile Cells after Vaccination.*

The average was found to be 1·4 per cent.

(i) *Basophile Cells before Vaccination.*

The average was found to be 0·16 per cent.

(j) *Basophile Cells after Vaccination.*

The average was found to be 0·16 per cent.

It has not yet been found possible to obtain estimations of the coagulability or alkalinity of calves' blood. The amount of haemoglobin noted is approximate only as it is obtained by Hammerschlag's observations as to the relation between the specific gravity and amount of haemoglobin.*

In connection therewith it should be noted that there was no evidence of dropsy in any animal of the series examined.

(k) *Haemoglobin before Vaccination.*

70 to 75 per cent (of the standard for human blood).

(l) *Haemoglobin after Vaccination.*

65 to 70 per cent (of the standard for human blood).

The subjoined table shows a summary of these observations.

—	Red Corpuscles.	White Corpuscles.						Specific Gravity.	Haemoglobin.
			Relative Count.						
	No. per Cubic Millimetre.	Actual Count. [No. per cubic Millimetre.]	Poly-nuclears.	Lympho-cytes.	Hyalines.	Eosino-philes.	Baso-philes.		
Before Vaccination	9,500,000	15,000	37·9%	57·3%	3·5%	1·2%	0·16%	1,054	70·75%
After Vaccination	9,100,000	16,000	41·6%	51·8%	5·1%	1·4%	0·16%	1,052	65–70%

* *Histology of the Blood*, by Ehrlich and Lazarus. *English Translation*, by Dr. Walter Myers.

The following further characteristics common to the blood of vaccinated and unvaccinated calves may be of interest.

Red Corpuscles.—As already noted, the average number of red corpuscles in normal calves' blood was found to be 9,500,000 per cubic millimetre, or almost double the number present in a cubic millimetre of normal human blood. But, in contradistinction to this greater *number* in the calf, the average *size* of well-shaped red cells is considerably less than in man, the average diametric measurement being 6·1 μ in thin evenly distributed films, whilst in man it averages 8·5 μ.

Red corpuscles of calves' blood possess a common feature in their marked tendency to crenation. This appearance was common in all dry films of the blood of the vaccinated and unvaccinated calves, though in some more than in others; it was as marked at the centre of a film as at its edge, and in a thin even film as in one thickly spread. Interspersed between crenated corpuscles well-shaped uncrenated corpuscles frequently appeared. Thus this crenation could not have been caused by the uneven drying of the film. Moreover, crenation of red cells appeared to be as marked in the haemacytometer cell when the corpuscles had been received directly from the body into fluid as in the dry film. In physiological human blood this marked tendency to crenation is not seen.

Normally, the red cells in a recent film stained a faint red with Jenner's stain, but those in films 24–48 or more hours old gained a progressively blue-red tint, and at the end of perhaps a week retained no red colouration.

Platelets.—These resembled the platelets of human blood.

Müller's haemoconiae.—These bodies morphologically resembling cocci were found to be present in every film.

The foregoing are the results obtained from the present series of experiments on calves' blood, and it is permissible now to consider their relation to the calf with regard to vaccination as set out at the beginning of this paper; that is, "to ascertain whether any variations which might obtain in the blood either before or after vaccination would show in the first place any relation to the health and general condition of the calf, and in the second place to the quality of vesicles yielded by the calf."

Knowledge of the health and general condition of each calf of a series is deduced from observations of various factors before and after vaccination, the following points being considered: the temperature, appetite, frequency of action of bowels, condition of excreta—degree of hardness or softness, whether offensive or not, presence or absence of parasites; condition of skin—presence or absence of slight jaundice, presence or absence of lesions and parasites; condition of coat; general aspect of animal—thinness, plumpness, alertness or lassitude. These factors must either be

slight in themselves or consist in comparatively trifling variations from the normal, for any important sign indicative of actual illness or unhealthiness of a calf would necessitate its rejection for vaccination purposes, and consequently no such animal would have been employed in this series of experiments.

Post mortem, no evidence of any disease was found in 19 of the animals; no autopsy was held on the remaining six, as they practically yielded no vaccine vesicles.

It would appear, therefore, that all the 25 animals which formed the subject of the observations of this paper were, during the process of vaccination, free from disease, and showed no marked deviation from the type of health. But the results of vaccination show that there were considerable variations in the receptivity and reaction of the calves to the vaccine virus, and this in spite of the fact that all the strains of vaccine used to inoculate the calves were of first rate quality and gave first rate results on calves outside this series of experiments. Now, of the 25 animals examined in this series, 14 yielded vesicles of good quality, 5 gave vesicles of poor quality, while the remaining six gave vesicles of very poor quality, or practically none at all. Since the calves showed no such marked differences in their general health, such variations of reaction must be ascribed to more subtle factors, and these though not entirely dependent upon the health of the animal, are certainly very closely related to it; so that an animal which reacts feebly to vaccination is said to be "out of condition." To elucidate this matter was the chief object of these experiments.

It has been already seen that of the variations in the blood before and after vaccination the chief were :—

(i.) Variations in the specific gravity, which were extensive and were traceable to fluctuations in the intestinal evacuations, such as diarrhœa.

(ii.) Variations in the number of white cells. These were considerable, but no relation could be traced between them and the reaction of calves to vaccination.

(iii.) Variations in the number of polynuclear cells in the blood. The variations in these cells, however, were especially noticeable in calves before vaccination; in three cases noticeable excesses, namely, 45·8 per cent., 46·9 per cent., and 57·3 per cent., were found.

In two of these three cases the vaccines yielded were of poor quality, while in the third case the vaccine was of very poor quality. In a fourth case, however, where polynuclear cells were present before vaccination in the proportion of 49·7 per cent., the calf yielded vaccine of good average quality. Hence an excess of polynuclear cells in the blood before vaccination is not necessarily followed by the production on the calf of vesicles of poor quality, and the two do not bear a constant relation. Could it be possible, indeed, for larger excesses of polynuclear cells to be present in the blood of calves, apparently only affected by "poor condition,"

but in reality suffering from some slight pathological change, which in the present state of our knowledge we are obliged to include under "condition," examination of such cases might afford more conclusive evidence on this point. So far at any rate the examination of the blood has thrown no definite light on the reacting powers of calves to the vaccine virus.

With regard to the third point at the beginning of this paper: "To ascertain whether the process of vaccination be accompanied by any material change as indicated by alterations in the blood," the only changes to be noticed were, firstly, a slight leucocytosis after vaccination in all but four cases; and secondly, a slight increase of polynuclear cells present in every case after vaccination, the average increase being 3·7 per cent. And of these two results of the process of vaccination, it may be safely said that neither of them could in any way be permanently detrimental, nor indeed would they be likely to be so even temporarily.

In conclusion, it must be fully recognised that the foregoing remarks have been deduced from observations on only 25 animals, comprising in all 50 examinations, and though from this number it might seem premature to make definite statements on the points at issue, yet it is probable that had any really important variations or changes of "condition" existed bearing a relation to the histological elements of the blood, this number of experiments would have sufficed to afford definite indications of their presence.

PLATE XXXI

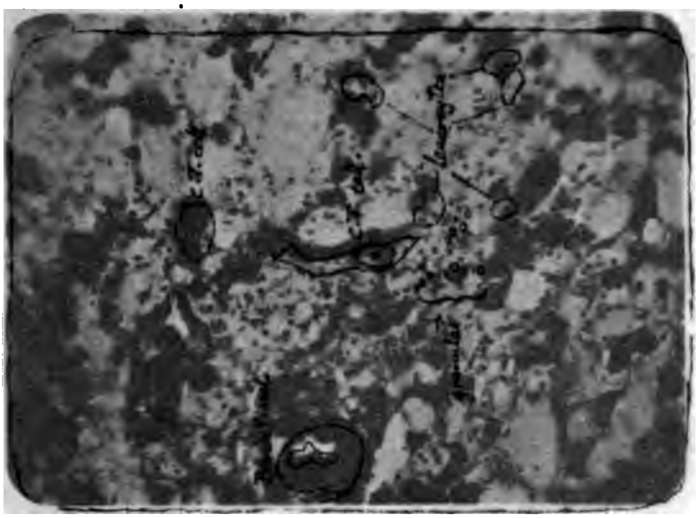
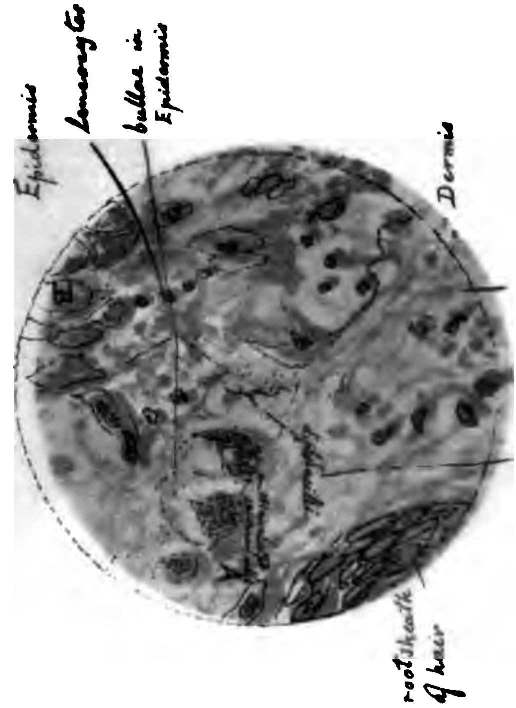


FIG. 28.



C.T. papillae with greatly enlarged lymphspaces

FIG. 27

[illegible] in reality suffering from some slight pathological [illegible] [illegible] present state of our knowledge we are obliged to [illegible] of such cases [illegible] [illegible] on this point. So far at any rate [illegible] the blood has thrown no definite light on the [illegible] to the vaccine virus.

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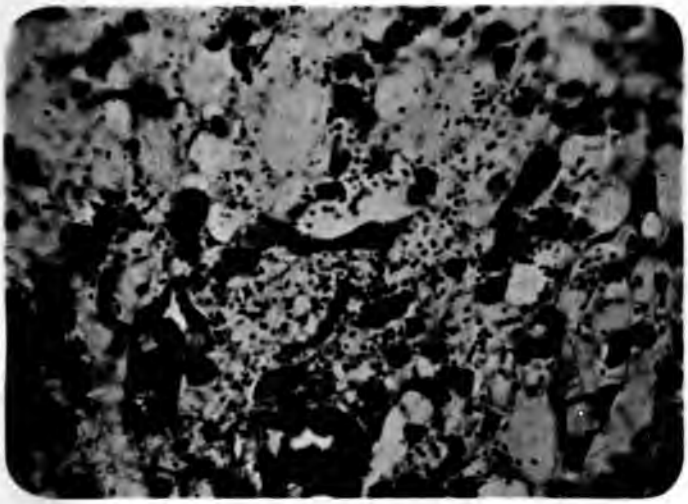
I [illegible] recognised that the foregoing [illegible] from observations on only [illegible] animals, [illegible] and [illegible] this [illegible] [illegible] on the [illegible] important [illegible] [illegible] vaccination [illegible] related [illegible] [illegible] of the blood, [illegible] [illegible] to afford definite [illegible] of the [illegible]



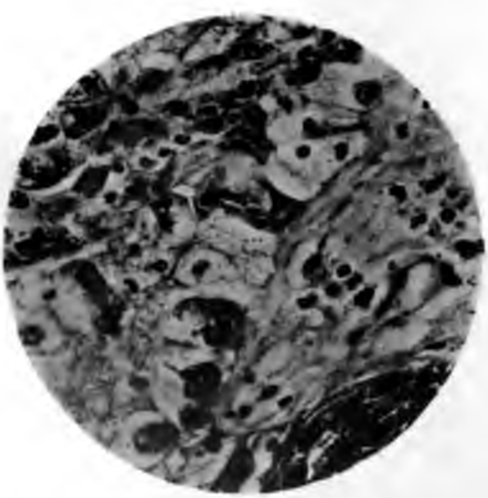


PLATE XXXII.

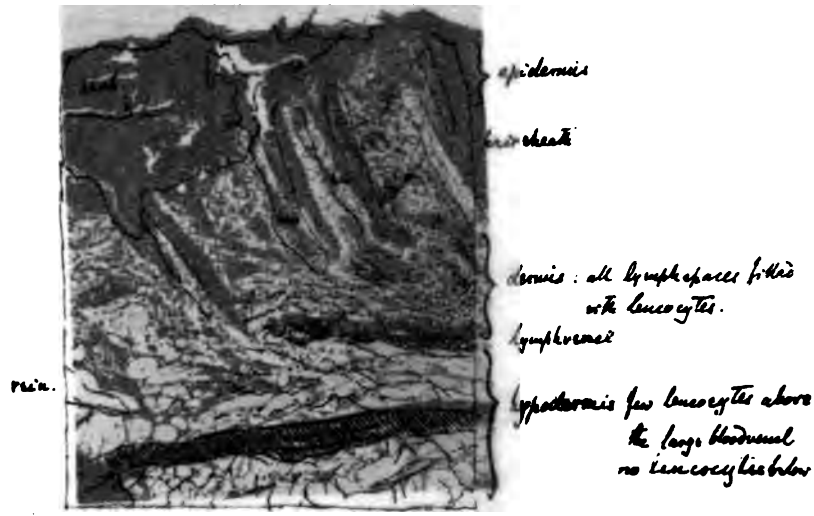


FIG. 29.

leucocyte infiltration of the dermis hypodermal elements are not invaded although often

FIG. 30.

FIG. 31.

PLATE XXXII.

FIG. 82.

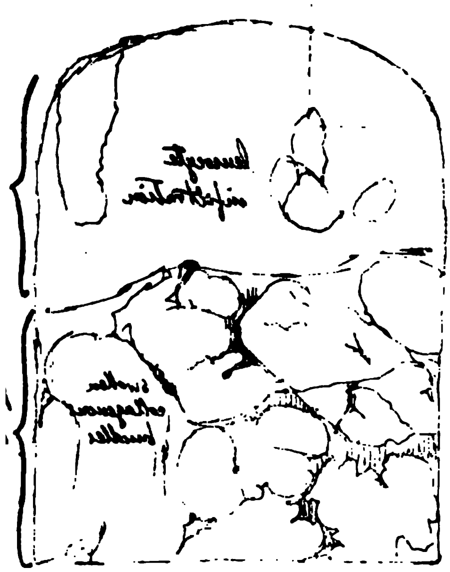


FIG. 81.

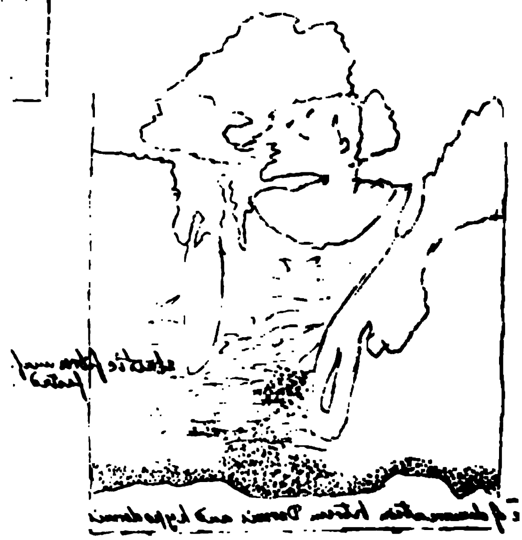


FIG. 80.

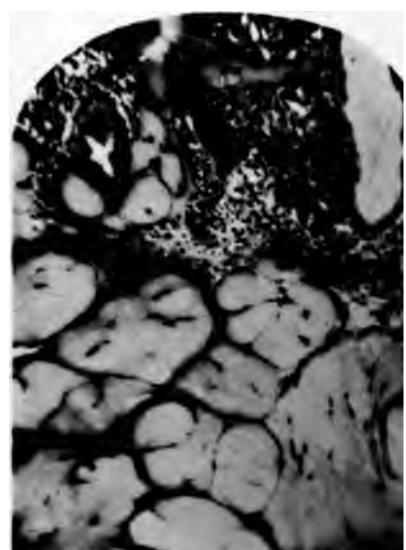


PLATE XXXII.

Fig. 29–31.

Leucocyte infiltration of the dermis 72 hours after vaccination.

Fig. 30 shows the elastic fibres as yet unaffected.
Figs. 29 and 30 are magnified by 50.
Fig. 31 is magnified by 300.

PLATE XXXIII.

Figs. A.–C.

Vertical section of skin of calf 120 hours after vaccination All three photographs are taken from the same section. Fig. A. is taken at the periphery of the section, and Fig. C. close to the line of inoculation.

[Magnified by 300.]

PLATE XXXIII.

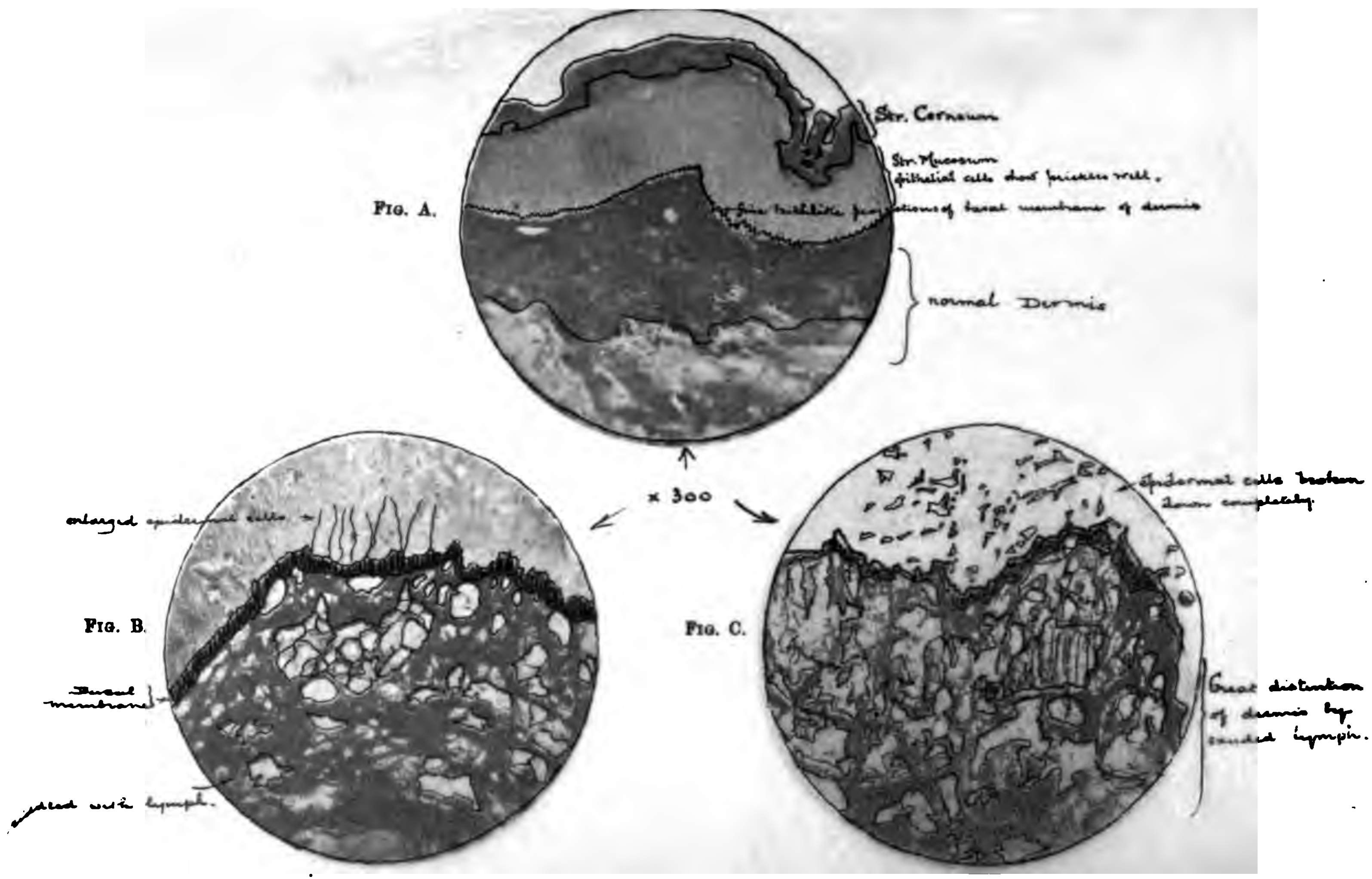


FIG. A.

FIG. B.

FIG. C.

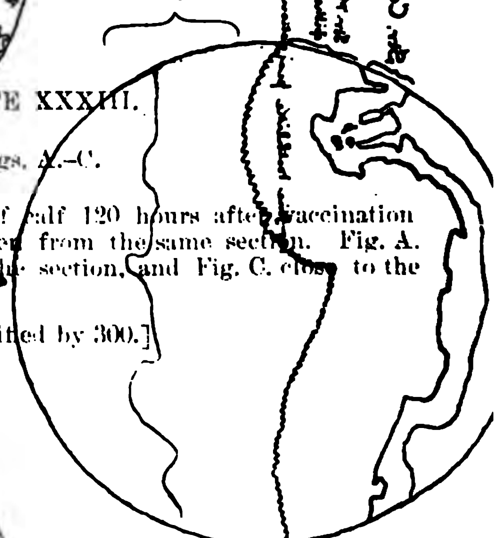
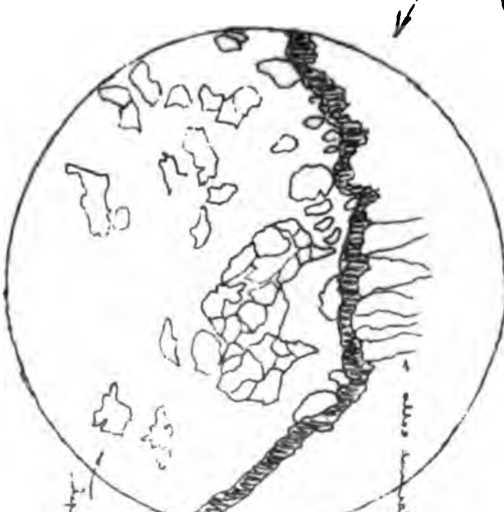


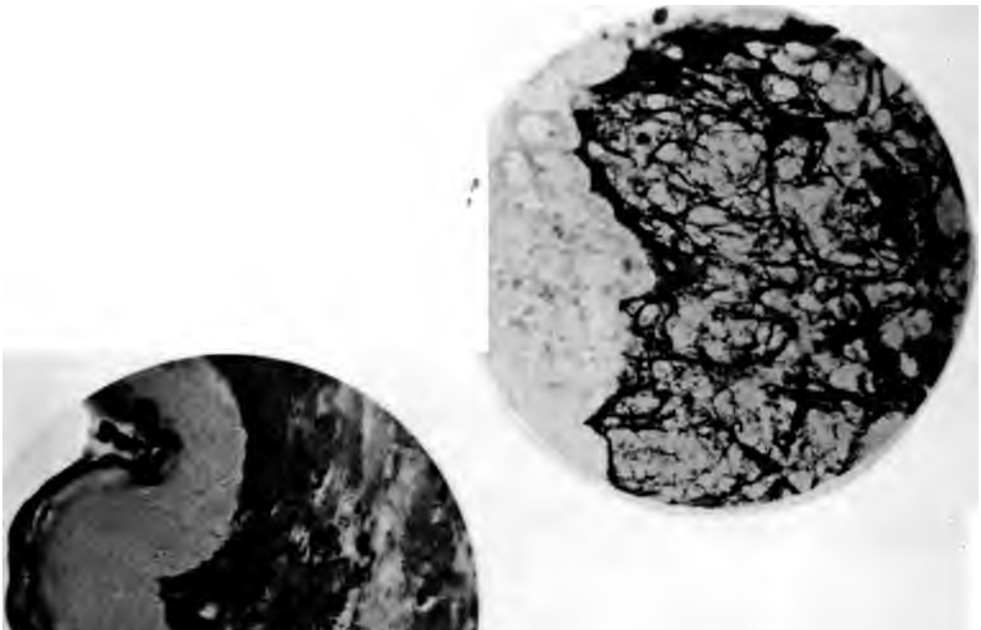
PLATE XXXIII.

Figs. A.–C.

Vertical section of skin of calf 120 hours after vaccination All three photographs are taken from the same section. Fig. A. is taken at the periphery of the section, and Fig. C. close to the line of inoculation.

[Magnified by 300.]





APPENDIX D.

Index to the LOCAL VISITATIONS which have been made by MEDICAL INSPECTORS under the direction of the LOCAL GOVERNMENT BOARD, from the date of the ESTABLISHMENT of the BOARD to the end of 1898, with regard to the INCIDENCE of DISEASE on particular places, and to questions concerning LOCAL SANITARY ADMINISTRATION.

The names of localities inspected are arranged alphabetically. The reports printed in *italics* have been reproduced in the medical officer's annual volumes; those marked* have been separately placed on sale; and those marked† have not been printed.

[*See* further index on page .]

The inspections made in connexion with the Cholera Survey of 1885–86 *and the Inland Sanitary Survey of* 1893–95 *are tabulated at the end of the above Index, and will also be found tabulated in the Report of* 1885 *on Cholera* [*C.* 4873], *in the Annual Volume of* 1886 *of the Medical Officer* [*C.* 5171], *and in the Report of* 1897 *on the Inland Sanitary Survey of* 1893–95 [*C.* 8215].

No tabulation has been made of the Port and Riparian Districts inspected in 1893–94, *in connexion with the Port and Riparian Sanitary Survey of that period. The inspection of such districts forms the subject of a special Report, issued in* 1895 [*C.* 7812].

No.	Locality Inspected.	Medical Inspector.	Year.
1	Abergele and Pensarn U.	Dr. Parsons ...	1881
2	Abingdon U.	„ Thorne... ...	1872
3	Alcester Town†	„ Ballard ...	1875
4	Aldbrough*	„ Reece	1897
4a	Aldeburgh-on-Sea U.	„ Sweeting ...	1898
5	Aldershot U.†	„ Turner... ...	1886
6	Alnwick and Canongate U.*	Mr. Spear	1884
6a	*Alnwick U.**	Dr. Buchanan ...	1898
7	Alton Registration District	„ Sweeting ...	1893
8	Alvaston and Boulton U.†	„ Parsons ...	1890
9	Amble U.†	Mr. Power	1883
10	Amlwch	„ Evans	1893
11	Ampthill R.†	Dr. Thorne... ...	1882
12	Andover R.†	„ Blaxall ...	1882
13	Andover U.	„ Thorne... ...	1872
13a	Appleby (not issued)	„ Corfield ...	1871
14	Appleby	„ Ballard ...	1873
15	"Arethusa" Training Ship†...	Mr. Power	1880
16	*Arlford (near Chester)*	Dr. Ballard ...	1881
17	*Armley*	Do. ...	1872
18	*Arnesby (printed only in annual volume)* ...	Mr. Spear	1887
19	*Ascot*	Dr. Ballard ...	1877
20	Ash†	Mr. Power	1876
21	Ash†	Dr. Turner ...	1886
22	*Ashbourne U.**	„ Bruce Low ...	1888
23	Ashby de la Zouch R.	„ Parsons ...	1892
24	Ashby Woulds U.	Do. ...	1892
25	Ashton-in-Makerfield U.	Mr. Radcliffe ...	1872
26	Ashton-in-Makerfield U.	Dr. Wheaton ...	1893
27	Ashton-under-Lyne U.	„ Ballard ...	1882
28	Atherstone and Polesworth	„ Airy	1878
29	Atherstone R.*	„ Wheaton ...	1893
30	Atherton Registration Sub-District ...	Mr. Power	1877
31	Atherton U.	Dr. Parsons ...	1886
32	Auckland Registration District	„ Thorne ...	1874
33	Aveley†	Mr. Spear	1880
34	*Avon Llwyd Valley**	„ T. W. Thompson	1895
35	Axminster†	Dr. Blaxall ...	1874
36	Aylesbury R.	„ Thomson ...	1891
37	*Aylesbury U.*	„ Gresswell ...	1888
38	*Aylesbury U.**	Mr. Spear	1888
39	Balby-cum-Hexthorpe	Dr. Thorne... ...	1873
40	Baldock U.	Do.	1874
41	Bangor U.†	Dr. Barry	1884
42	*Bangor U. and R. and Bethesda U.*	Do.	1882
43	Barking	Dr. Harries ...	1873
44	Barking (Lodge Farm)	„ Buchanan ...	1873
45	Barkingside	„ Thorne ...	1880
46	Barnham Broom*	Mr. T. W. Thompson	1894
47	Barnstaple, Bideford, and Ilfracombe ...	Dr. Reece	1894
48	Barnstaple R.*	„ Bruce Low ...	1890
49	*Barrowby*	„ Parsons ...	1890
50	Barrow-in-Furness U.	Mr. Radcliffe ...	1872
51	Barrow-on-Soar Registration District ...	Dr. Barry	1883
52	Barrow-on Soar R.†	Do.	1883
53	Barrow-on-Soar R.†	Dr. Parsons ...	1886
54	Barton-on-Irwell Registration District ...	„ Stevens ...	1874
55	Basingstoke U....	„ Ballard ...	1871
56	Bath R.†	„ Thorne ...	1880

No.	Locality Inspected.	Medical Inspector.	Year
57	Battle Registration District (part of) ...	Dr. Airy	1878
58	Bedale	Mr. Power	1877
59	Beddington Royal Female Orphan Asylum*	Dr. Gresswell ...	1886
60	Bedlingtonshire U.	" Parsons ...	1879
61	Bedlingtonshire U.*	Do.	1889
62	Bedwellty Registration District	Mr. Spear	1882
63	Bedwellty Registration District	Do.	1884
64	*Berkhampstead R.**	Dr. Blaxall ...	1890
65	Berwick-upon-Tweed U.*	" Page	1888
65a	Bettws-y-Coed R.*	" Wheaton ...	1898
66	*Beverley U.**	" Page	1884
67	*Bewdley U.*	" Thomson ...	1897
68	*Bicester U.**	Do.	1896
69	Biddenden U.	Dr. Thorne ...	1879
70	Bierley Lane	Do.	1874
71	Bilston Registration Sub-District	Dr. Ballard ...	1874
72	Bingham†	" Thorne ...	1872
73	*Birmingham and Aston*	" Buchanan ...	1874
74	Bishop's Lydiard, &c.	" Blaxall ...	1882
75	Bishop's Stortford R.	Mr. Sweeting ...	1885
76	Bishop's Stortford U.	Dr. Thorne... ...	1873
77	Blaby R....	" Blaxall ...	1880
78	Blackburn R.	" Parsons ...	1889
79	*Blackburn U. and R.*	" Airy	1881
80	Blackwater†	" Stevens ...	1876
81	Blackwater River†	" Turner ..	1886
82	Bleadon	Mr. Power	1879
83	Blyth Registration Sub-District	Dr. Airy	1872
84	Bodmin Registration District	" Parsons ...	1881
85	Bodmin R.†	Do.	1885
86	Bodmin U.†	Do.	1885
87	Bognor U.	Dr. Stevens ...	1874
88	Bolton Registration District	" Ballard ...	1871
89	Bourne Bridge and Stapleford Abbotts ...	" Airy	1881
90	Bourton-on-the-Water (*not issued*)	" Ballard ...	1874
91	Box†	" Blaxall ...	1880
92	*Bradford, &c., &c., &c. (Woolsorters' disease)*	Mr. Spear	1880
93	Bradford U. (Wilts)	Dr. Thorne ...	1877
94	Bradford U. (Yorks)	Mr. Radcliffe ..	1871
95	Brailes	" Power ...	1876
96	Brecknock R.	Dr. Fletcher ...	1895
97	Brecknock U.	" Harries ...	1873
98	Breedy Butts Farm	" Wilson... ...	1893
99	Brent River	" Copeman ...	1893
100	Brick Garth†	" Fletcher ...	1895
101	*Bridgend Registration District*	Mr. Spear	1888
102	Bridgwater U.	Dr. Blaxall ...	1874
103	Bridlington U....	" Parsons ...	1881
104	Brierley Hill U.	Do.	1832
105	*Brightlingsea U.**	Dr. Buchanan ...	1897
106	Brinkworth	" Bruce Low ...	1890
107	Brixworth R.	" Thorne ...	1874
108	Brixworth R.	" Parsons ...	1885
109	Broadstairs U.*	" Bruce Low ...	1894
110	*Bromley and Beckenham Joint Hospital District.*	Mr. T. W. Thompson.	1894
111	*Brownhills U.*	Do.	1892
112	Brownhills U.	Do.	1893
113	Brynmawr U.†	Do.	1895
114	Buckingham R.	Dr. Gresswell ...	1889
115	Buckingham U.	" Parsons ...	1888

No.	Locality Inspected.	Medical Inspector.	Year.
116	Bulwell	Dr. Harries ...	1871
117	Burnham U.	„ Blaxall ...	1883
118	Burnley U.	„ Beard	1873
119	Burnley U.	„ Airy	1884
120	Burton Latimer	„ Thorne ...	1872
121	Burton-on-Trent Registration District (part of).	„ Airy	1878
121a	*Burton-on-Trent U.**	„ Thomson ...	1898
122	Bury U.*	„ Copeman ...	1894
123	*Bury U.**	„ Bruce Low ...	1897
124	Bushey Parish	Mr. Royle	1897
125	*Bush Hill Park (printed only in annual volume).*	Dr. Copeman ...	1891
126	Buxted and Maresfield*	„ Airy	1887
127	Bywell Registration Sub-District†	Do.	1874
128	*Caius College, Cambridge*	Dr. Buchanan ...	1874
129	Calne U.	„ Blaxall ...	1874
130	Calne U.	Do. ...	1884
131	Calstock	Do. ...	1876
132	Calvert†	Dr. Bruce Low ...	1890
133	Camberley and York Town	„ Parsons ...	1889
133a	*Camborne U. and neighbourhood**	„ Bruce Low ...	1898
134	Cameley	„ Sweeting ...	1892
135	Camelford R†	„ Home	1872
136	*Camelford R.*	„ Ballard ...	1888
137	Campden	„ Harries ...	1873
138	Cannock U. and R. (Registration Sub-District).†	„ Ballard ...	1874
139	Carlisle U.	Mr. Power	1874
140	Carlton	Dr. Harries ...	1871
141	Carmarthen R.	Mr. Power	1878
141a	*Carnarvon U.**	Dr. Wheaton ...	1898
142	Carnarvonshire Combined Sanitary Districts	„ Bruce Low ...	1895
143	Castleford Registration Sub-District ...	„ Parsons ...	1880
144	Catshill	„ Ballard ...	1873
[145	*Cerebo Spinal Meningitis*]* *Eastern Counties*	„ Bruce Low ...	1890
146	Chalton	„ Buchanan ...	1896
147	Chalvey	Mr. Power	1876
148	Charles Registration Sub-District	Dr. Home	1872
149	Chatteris U.	Mr. Radcliffe ...	1875
150	Chelmsford U*	Dr. Reece	1896
151	*Chepping Wycombe U.*	„ Wheaton ...	1895
152	Chesham	Mr. Power	1871
153	Cheshunt U.†	Dr. Thorne ...	1875
154	Cheshunt U.*	Mr. Sweeting ...	1885
155	Chester U*	Dr. Ballard ...	1889
156	Chesterfield Registration District	„ Thorne ...	1874
157	*Chester-le-Street, R.**	„ Wilson... ...	1893
158	Chichester U.	„ Airy	1879
159	*Chichester U.**	„ Bulstrode ...	1896
159a	*Chichester U.**	„ Thomson (with Col. Marsh.)	1898
160	Chippenham R. (part of)	„ Blaxall ...	1884
161	Chippenham U. and R. (Registration District).	Do. ...	1874
162	Chipping Norton R.	Dr. Fletcher ...	1897
163	Chipping Sodbury R.	„ Ballard ...	1872
164	Chittlehampton	„ Home	1872
165	Chorley (Lancs.) U.	„ Parsons ...	1881

No.	Locality Inspected.	Medical Inspector.	Year.
165a	Christchurch (Hants.) U.*	Dr. Mivart... ...	1898
166	Clapham	„ Parsons ...	1882
167	Clayton, West, U.	„ Thorne ...	1874
168	Cleator Moor U.†	„ Page	1888
169	Clitheroe R.	„ Airy	1880
170	Coggeshall*	Do.	1882
171	Colne and Marsden U.†	Do.	1884
172	Combrooke	Dr. Ballard ...	1873
173	Congleton U.†	„ Page	1888
174	*"Cornwall" Training Ship*	Mr. Radcliffe ...	1877
175	*"Cornwall" Training Ship*	„ Power	1879
176	"Cornwall" Training Ship †	Do.	1881
177	Corwen R.	Dr. Parsons ...	1881
178	*Coslany Registration Sub-District* * ...	„ Airy	1888
179	Cowbridge U.	„ Bruce Low ...	1895
180	Cowpen U.	„ Parsons ...	1889
181	*Cradley**	„ Gresswell ...	1889
182	Cranbrook R.*	„ Airy	1887
183	Cranfield	„ Cory	1879
184	Cricklade and Wootton Bassett R.†... ...	„ Thorne ...	1880
185	Crofton	„ Copeman ...	1894
186	Crompton U.	„ Swete	1879
187	Croyde	„ Home	1872
188	Croydon R.†	„ Page	1883
189	*Croydon U.*	„ Buchanan ...	1875
190	Cumberworth U.	„ Barry	1891
191	Dalham†	Dr. Turner... ...	1886
192	Dartford Registration Sub-District† ...	Mr Spear	1884
193	Dartford R.	Dr. Thorne ...	1879
194	Dartford U. and R.	Mr. Spear	1882
195	Darton Registration Sub-District†	Dr. Bruce Low ...	1889
196	Dee Watershed*	Do. ...	1895
197	Denbigh...	Dr. Parsons ...	1881
198	Denbigh U.	„ Thorne... ...	1877
199	Derry Hill*	„ Horne	1893
200	Desborough U.*	„ Fletcher ...	1894
201	*Devonport**	„ Parsons ...	1883
202	Dewsbury†	„ Stevens ...	1874
203	Dewsbury Registration District	„ Thorne... ...	1878
204	Dingestow Registration Sub-District* ...	Mr. Spear	1888
205	Dolgelley U.	Dr. Parsons ...	1888
206	Doncaster U.	„ Thorne... ...	1873
207	*Donington and Moulton*	„ Page	1883
208	Donington and Moulton †	Do.	1884
208a	Dore R.	Dr. Fletcher ...	1898
209	Draycott†	„ Beard	1872
210	Droylesden U.†	„ Fletcher ...	1897
211	Dudley U.	„ Ballard ...	1874
212	Durham County	Mr. T. W. Thompson	1894
213	Durham Registration District	„ Spear	1881
214	Eagley	Mr. Power... ...	1876
215	*Ealing U.**	Do. ...	1887
216	Easington. R.	Do. ...	1879
217	Easingwold, R....	Dr. Barry ...	1890
218	East Haddon	„ Bruce Low ...	1889
219	*Eastry R.*	Mr. Spear	1887
220	Eaton Bray R....	Dr. Wheaton ...	1897

No.	Locality Inspected.	Medical Inspector.	Year.
221	*Ebbw Fach Valley**	Mr. T. W. Thompson	1895
222	*Ebbw Fawr Valley**	Do. ...	1895
223	*Ebbw Main Valley**	Do. ...	1895
224	Ecton	Dr. Buchanan ...	1872
225	Edmondsley	„ Harries ...	1873
226	Edmonton U.	„ Parsons ...	1880
227	Ely R.†	Do. ...	1885
228	Enfield U.	Do. ...	1880
229	*Enfield U**	Dr. Bruce Low ...	1888
230	*Enfield Workhouse**	„ Copeman ...	1895
231	Erpingham R.	„ Gresswell ...	1885
231a	Eton R.*	„ Johnstone ...	1898
232	Evershholt*	„ Parsons ...	1884
233	Exeter U.	„ Fletcher ...	1895
234	Exmouth U	„ Parsons ...	1888
235	Faldingworth and Barlings	Dr. Gresswell ...	1885
236	*Fallowfield*	„ Airy	1879
237	*Fareham Registration District**	Mr. Spear	1888
238	*Faringdon R.*	Do. ...	1889
239	Farnborough†	Dr. Turner ..	1886
240	Farnham Registration District	Mr. Sweeting ...	1885
241	Farnham U†	Dr. Turner ...	1886
242	Faversham R.	Mr. Power ...	1880
243	Faversham U.	Do. ...	1880
244	Faversham U. and R. (Registration Sub-District).	Do. ...	1875
245	Felstead	Dr. Airy	1880
246	Festiniog Registration Sub-District (R) ...	„ Blaxall ...	1875
247	Festiniog U.*	Mr. Evans	1894
248	Fleetwood-on-Wyre U.	Dr. Harries ...	1873
249	Flint U.†	Mr. Spear	1888
250	*Flint U.**	Dr. Reece	1895
251	Foleshill R.†	„ Ballard ...	1874
252	Foleshill R.	„ Parsons ...	1891
253	Folkestone	Do. ...	1882
254	Forest Row and East Hoathley	Dr. Airy	1880
255	Frimley†	„ Turner... ...	1886
256	Fulbeck	„ Wheaton ...	1896
257	Gainsborough Union	Mr. Radcliffe ...	1876
257a	Gainsborough U.*	Dr. Mair	1898
258	Galgate	„ Barry	1882
259	Gateshead U.*	Do.	1883
260	*Gillingham U.**	Dr. Sweeting ...	1896
261	Glanaber	„ Airy	1880
262	Glanford Brigg R.	„ Gresswell ...	1885
262a	Glyncorwg U.	Mr. Royle	1898
263	Godalming and Farncombe	„ Power	1874
264	Godmanchester U.	Dr. Parsons ...	1884
265	Goole U..	„ Home	1871
266	Grampound	„ Corfield ...	1871
267	Gravesend U.	Mr. Radcliffe ...	1877
268	Gravesend U.*	„ S. F. Murphy...	1885
269	Grays Registration District	Dr. Airy	1889
270	Great Baddow Registration Sub-District (part of).	Do.	1873
271	Great Coggeshall	Dr. Thorne... ...	1876
272	Great Dunmow*	„ Airy	1883

No.	Locality Inspected.	Medical Inspector.	Year.
273	Great Grimsby U.	Dr. Home	1871
274	Great Grimsby U.	„ Parsons ...	1881
275	Great Massingham	„ Thorne ...	1877
276	Great Milton	Do.	1872
277	Great Ormond Street Hospital	Mr. Power	1880
278	Great Ouseburn R.†	Dr. Wheaton ...	1897
279	Great Tey†	„ Copeman ...	1893
280	Great Yarmouth	„ Airy	1875
281	Guildford R.†	Mr. Power	1882
282	Guisbrough Registration District (part of)	Dr. Thorne ...	1875
283	Guisbrough U.	„ Harries ...	1873
284	Gunnislake	„ Blaxall ...	1881
285	*Halifax*	Dr. Ballard ...	1881
286	*Halstead Registration District**	„ Bruce Low ...	1889
287	Hambledon, &c *	„ Parsons ...	1884
288	Hambledon R.*	„ Airy	1887
289	Handsworth U.	„ Ballard ...	1875
290	Hanley U.*	Mr. Spear	1889
291	Hanwell	Dr. Thorne ...	1876
292	Hastings (St. Mary-in-the-Castle Sub-District)†	Mr. Spear	1890
293	*Hastings U. and R.**	Dr. Bruce Low ...	1894
294	Hatfield R.	Do.	1889
295	Hatley Cockayne	Dr. Buchanan ...	1896
296	Haverfordwest R. (*not issued*)†	„ Swete	1879
297	Haverfordwest	„ Parsons ...	1880
298	Hayfield R.	Do. ...	1886
299	Hayle U.*	Dr. Mivart ...	1897
300	Heage U.	„ Parsons ...	1883
301	Heath Town U.	Mr. Spear	1884
302	Hebden Bridge Registration Sub-District ...	Dr. Gresswell ...	1885
303	Helmsley R.*	„ Bruce Low ...	1895
304	Helston, Falmouth, and Redruth U. and R.†	„ Ballard ...	1882
305	*Helston R.**	„ Parsons ...	1887
306	*Helston U.**	Do. ...	1887
307	Hemel Hempstead R....	Mr. Sweeting ...	1885
308	Hendon R.	Dr. Bruce Low ...	1892
309	*Hendon U.**	Mr. Power	1883
310	Henley and Barham	Dr. Airy	1880
311	Hepworth U.	„ Barry	1891
312	Hersham†	„ Thorne ...	1872
313	Hetton-le-Hole Registration Sub-District ...	Mr. Power	1874
314	Hetton-le-Hole†	Dr. Fletcher ...	1895
315	Heywood U.	Mr. T. W. Thompson.	1892
316	Higham Ferrers	Dr. Home	1871
317	Hinckley U.†	„ Airy	1881
318	*Hinckley U. and R.**	„ Wheaton ...	1893
319	Hinckley U. and R.*	Do.	1894
320	Hindley U.†	Mr. Spear	1882
321	Hindley U.	Dr. Parsons ...	1886
322	Hitchin R.	Mr. Sweeting ...	1885
323	*Hitchin U.**	„ Power	1883
324	Holbeach R.	Dr. Parsons ...	1882
325	Holbeach U.*	Mr. Evans	1895
326	Hollingbourn R.	Dr. Parsons ...	1886
327	Holme Cultram U.	Do.	1888
328	Holyhead R.†	Mr. Harvey ...	1886

No.	Locality Inspected.	Medical Inspector.	Year.
329	Holyhead U. and R. (Registration Sub-District).	Dr. Ogle	1879
330	Holywell Parish	„ Mivart	1896
331	Holywell Registration District	„ Blaxall	1875
332	Holywell R.	„ Parsons	1881
333	Holywell U.	Do	1881
334	Hoo R.	Dr. Airy	1881
335	Hoo R.	Mr. Spear	1889
336	Horningsham†	„ Power	1876
337	Horsforth U.*	Dr. Bruce Low	1897
338	Horwich Registration Sub-District	Mr. Spear	1889
339	*Houghton-le-Spring R.**	Dr. Page	1889
340	Howden R.	Mr. Spear	1881
341	Hucknall Torkard U.	Dr. Harries	1872
342	Hucknall Torkard U.*	„ Horne	1894
343	Hucknall Torkard U.*	„ Buchanan	1896
344	Hucknall-under-Huthwaite U.†	„ Harries	1873
345	Huddersfield U.	„ Buchanan	1872
346	Hull U.	„ Airy	1882
347	Huntingdon Registration District	„ Parsons	1880
348	Huntingdon U.	Do.	1884
349	Huntingfield	Dr. Mivart	1896
350	Hythe and Bramshaw*	„ Bulstrode	1894
351	Ilkeston U.	Dr. Blaxall	1881
352	Ilminster	Do.	1871
353	Ince-in-Makerfield U.	Dr. Parsons	1879
354	*Ivybridge U. (Reprinted in Volume for 1886)* (Small-pox among Rag-sorters).*	Do.	1887
355	Keighley and Oakworth†	Dr. Stevens	1875
356	Kempston*	Mr. Sweeting	1885
357	Kessingland*	Dr. Bruce Low	1896
358	Keynsham R.	„ Blaxall	1888
359	Kidderminster U.*	„ Parsons	1884
360	Kidderminster U.	Do.	1885
361	Kilburn and St. John's Wood	Mr. Power	1878
362	*Kilkhampton*	Dr. Parsons	1888
363	Killingworth	„ Airy	1872
364	Kingsbridge R.†	„ Ballard	1882
365	Kingsclere and East Woodhay R.	„ Blaxall	1884
366	King's Lynn	„ Airy	1882
367	*King's Lynn and Gaywood*	„ Bruce Low	1892
368	*King's Lynn and Gaywood**	„ Mivart	1897
369	*Kirkheaton U.*	„ Barry	1891
370	Knighton Registration District	„ Airy	1878
371	Lakenheath	Dr. Copeman	1892
372	Lambeth†	„ Buchanan	1873
373	*Lancaster U.**	„ Thomson	1897
374	*Laxfield**	„ Bruce Low	1894
375	Launceston R.†	„ Parsons	1884
376	Leek R.	Do.	1889
377	Leigh (Lancashire)	Mr. Power	1872
378	Lenton U. (now part of Nottingham)†	Dr. Thorne	1875
379	Lepton U.	„ Barry	1891
380	Lewes Registration District	„ Thorne	1874
381	Leyton†	„ Sweeting	1893

No.	Locality Inspected.	Medical Inspector.	Year.
382	Limsfield	Dr. Copeman ...	1892
383	Linslade	„ Bulstrode ...	1894
384	Littleport	„ Thorne ...	1873
385	Llandcwyrcwm	„ Airy	1880
386	Llandissilio Registration Sub-District ...	Mr. Spear	1888
387	Llanelly	Dr. Harries ...	1872
388	Llanelly†	„ Blaxall ...	1876
389	Llanelly U.	„ Parsons ...	1880
390	Llanfrechfa, Upper, U.†	Mr. Spear	1883
391	Llanfyllin R.	Dr. Parsons ...	1881
392	*Llanfynydd*	„ Sweeting ...	1895
393	Llangollen U.	„ Parsons ...	1881
394	Llanllyfni and Llanwnda	„ Airy	1880
395	Llanrhaiadr	„ Thorne ...	1877
396	Llanwddyn	„ Parsons ...	1888
397	*Loddon**	„ Copeman ...	1895
398	London, Southern Districts†	Mr. Radcliffe ...	1872
399	*London, Port of*†	Dr. Buchanan ...	1896
400	Long Benton	„ Sweeting ...	1894
401	Long Buckby*	„ Bruce Low ...	1896
402	Long Eaton U.†	„ Turner ...	1886
403	Longton U.*	Mr. Spear	1889
403a	Longton U. and Fenton U.*	Dr. Fletcher ...	1898
404	*Loughton*	Mr. Power	1878
405	Loughton†	„ Spear	1880
406	*Lower Brixham U.*	Dr. Blaxall ...	1888
407	Lower Sheringham†	„ Airy	1885
408	Lowestoft U.*	„ Copeman ...	1896
409	Ludgvan U.*	„ Sweeting ...	1896
410	Ludlow U. and R. (Registration District)...	„ Airy	1876
410a	Lunesdale R.†	„ Fletcher ...	1898
411	Lurgashall	„ Airy	1880
412	Lymington U.	Do.	1878
413	Lympsham	Mr. T. W. Thompson	1895
414	Macclesfield Registration District (part of)	Dr. Thorne ...	1873
415	Machynlleth Registration District	„ Airy	1876
416	Maesteg U.*	Mr. Spear	1889
417	Manchester Royal Infirmary...	„ Radcliffe ...	1876
418	Manorbier	Dr. Airy	1880
419	*Mansfield District**	„ Buchanan ...	1896
420	Mansfield Registration District	„ Gresswell ...	1885
421	Margate U. (*not issued*)	„ Harries ...	1873
422	Margate U.*	„ Page	1887
423	Marham†	„ Parsons ...	1887
424	Market Weighton†	Mr. Royle ...	1885
424a	Marston, Hingham, and Long Bennington...	Dr. Wheaton ...	1898
425	*Marylebone, St.*	Messrs. Radcliffe and Power.	1873
426	Maryport U.	Mr. Spear	1882
427	Mathry and Llanrian	Dr. Parsons ...	1880
428	Melton Mowbray R.†	„ Blaxall ...	1881
429	*Melton Mowbray U.*	Do.	1880
430	Mendham	Dr. Airy	1873
431	Merrow	„ Horne	1893
432	Messingham†	„ Bruce Low ...	1897
433	Mexborough U.	„ Thorne ...	1873
434	*Middlesbrough U.**	„ Ballard ...	1888
435	Middlesbrough U.*	„ Bruce Low ...	1896
436	*Midsomer Norton U.**...	„ Blaxall ...	1888

No.	Locality Inspected.	Medical Inspector.	Year.
437	Millbrook	Dr. Ballard ...	1880
438	Millbrook†	Do.	1882
439	Moggerhanger	Dr. Buchanan ...	1896
440	Mold U.*	" Wheaton ...	1894
441	Monmouth Registration District	" Fletcher ...	1892
442	Monmouth U.	" Pirrie	1872
443	*Moseley and Balsall Heath*	" Ballard ...	1873
444	Motcombe	" Simpson ...	1885
445	Moulton†	" Turner... ...	1886
446	*Mountain Ash U.**	Mr. Spear	1887
447	Mytholmroyd (in four Sanitary Districts)*	Dr. Page	1888
448	"*Nazareth House,*" *Hammersmith*	Mr. Spear	1883
449	Neath Registration District	Dr. Airy	1877
450	*Neath R.* (*part of*)	Mr. Spear	1890
451	Necton†	Dr. Airy	1876
452	Newark U.	" Parsons ...	1885
453	*New Brighton**	Mr. Spear	1888
454	*New Clee**	Dr. Page	1888
455	New Delaval*	" Sweeting ...	1894
456	New Hincksey	" Thorne ...	1872
457	Newlyn†	" Blaxall ...	1877
458	Newlyn East	" Ballard ...	1880
459	New Malden U.†	Do. ...	1871
460	*Newport U., &c.**	Dr. Thomson ...	1894
461	Newport Pagnell R. (part of)	" Thorne ...	1872
462	Newport Pagnell R.	" Parsons ...	1884
463	New Quay (Cardigan) U.†	" Fletcher ...	1892
464	New Quay (Cornwall) U.	" Ballard ...	1879
465	New Shoreham U.†	" Thorne ...	1882
466	Newton Heath U.†	Do. ...	1880
467	Newtown and Llanllwchaiarn U.	Dr. Blaxall ...	1877
468	Newtown and Llanllwchaiarn U.†	Do. ...	1880
469	Nocton Rise Farmhouse†	Dr. Gresswell ...	1885
470	Normandy†	" Horne	1893
471	Northallerton U.†	" Page	1887
472	Northampton Lunatic Asylum	" Buchanan ...	1875
473	North and South Tawton	" Blaxall ...	1881
474	*North London (3 Districts)**	Mr. Power	1885
475	*Northop Hall*	" Spear	1890
476	Norwich : Norfolk and Norwich Hospital...	" Radcliffe ...	1875
477	*Norwood (Uxbridge R.)*	" Power	1882
478	Nottingham	Dr. Ballard ...	1881
479	Nottingham U....	" Thorne ...	1871
480	Nunney	" Ballard ...	1872
481	*Oaksey*	Dr. Downes ...	1883
482	*Okehampton R.*...	" Blaxall ...	1887
483	Okehampton U.	Do. ...	1879
484	Oldbury U.	Dr. Ballard ...	1875
485	Oldham Registration District (part of) ...	" Stevens ...	1875
486	Oldham U.	" Beard	1872
486*a*	Ormskirk U.*	" Copeman ...	1898
487	Ormskirk R	" Parsons ...	1883
488	Orsett R.	Mr. Spear	1883
489	Oswaldtwistle U.	Do.	1887
490	Ovenden U.	Dr. Thorne ...	1873
491	Over Darwen U.	" Stevens ...	1874

No.	Locality Inspected.	Medical Inspector.	Year.
492	Padstow U.	Dr. Blaxall ...	1877
493	Pemberton U.	„ Airy	1880
494	Pemberton U.	Mr. Spear	1890
495	*Pembroke R.*	Do.	1890
496	Pembroke U.	Dr. Airy	1878
497	Pembroke U.	„ Reece	1895
498	Penistone Registration Sub-District * ...	Mr. Spear	1889
499	Penistone U.	Dr. Thorne ...	1879
500	Penkridge	„ Airy	1876
501	Penrhynside	„ Bruce Low ...	1896
502	Penrith U.*	Do. ...	1894
503	Perry Street, Kent	Dr. Thorne ...	1871
504	Peterchurch	Do.	1877
505	Petersfield R.†	Dr. Turner ...	1886
506	Phillack *	„ Mivart... ...	1897
507	Phillack U.†	„ Reece	1895
508	*Pirbright*	Mr. Power... ...	1882
509	Pirbright †	Dr. Horne	1893
510	Plymouth U. (*Two Reports*)	„ Blaxall ...	1878
511	Plymouth	Do.	1882
512	Plympton St. Mary R.†	Dr. Ballard ...	1882
513	Pocklington	Mr. Evans	1893
514	Pontardawe Registration District (R.) ...	Dr. Parsons ...	1880
515	Pontefract Registration Sub-District (part of) † (*not issued*)	„ Beard	1875
516	Pontypool Registration District (part of) ...	„ Ogle	1879
517	Pontypridd Registration District	„ Airy	1876
518	Pontypridd Registration Sub-District * ...	Mr. Spear	1889
519	Poole *	Dr. Bulstrode ...	1893
520	Porchester	„ Stevens ...	1872
521	Portland U.†	„ Blaxall ...	1886
522	Portsmouth	„ Thomson ...	1896
523	Portsmouth U....	„ Thorne ...	1876
524	Potterne *	„ Copeman ...	1894
525	Potterspury	„ Bulstrode ...	1895
526	Potterspury R.†	„ Thorne ...	1875
527	Potton *	„ Parsons ...	1882
528	Putney †...	„ Blaxall ...	1883
529	Pwllheli R.	„ Parsons ...	1887
530	Pwllheli U.*	Do.	1887
531	Quarry Bank U.	Dr. Wheaton ...	1895
532	Queen Camel *	„ Parsons ...	1888
533	Quickmere U.	Mr. Spear	1879
534	Radford	Dr. Thorne ...	1872
535	Radwinter	Mr. Power... ...	1877
536	Rainham*	„ Evans	1894
537	Ramsey U.	Dr. Airy	1875
538	Raunds	Do.	1880
539	Raunds*...	Dr. Bruce Low ...	1895
540	Raunds and Heyford	Do.	1891
541	*Rawdon U.*	Dr. Barry	1890
542	Rawdon U.†	Do.	1891
543	Redditch U.†	Dr. Ballard ...	1873
544	*Redhill and Caterham*	„ Thorne ...	1879
545	Redruth Registration District	„ Blaxall ...	1876
546	*Retford, East,* R. (*printed only in annual volume*).	Mr. Spear	1887

No.	Locality Inspected.	Medical Inspector.	Year.
547	Rhayader R.†	Mr. Spear	1889
548	Rhymney U.†	„ Power	1880
549	Risca	Dr. Fletcher ...	1893
550	Rochdale	„ Thorne ...	1882
551	*Rochester U.*	Mr. Spear	1889
552	Romford R.	Dr. Parsons ...	1884
553	*Rotherham, Rawmarsh, and Greasborough* (1892 *vol.*).	„ Thomson ...	1891
554	Rotherham U.	„ Ballard ...	1872
555	Rotherhithe	„ Thomson ...	1893
556	Rothwell U.†	„ Parsons ...	1882
557	Rowley Regis U.	„ Ballard ...	1874
558	Royston R.	„ Thorne ...	1876
559	*Rumney Valley**	Mr. T. W. Thompson	1895
560	Runcorn U.	Dr. Airy	1874
561	Runcorn U.*	Mr. Spear	1890
562	Ruthin R.	Dr. Parsons ...	1881
563	Ruthin U.	„ Home	1871
564	Ruthin U.	„ Parsons ...	1881
565	Rye R.*	Mr. Spear	1889
566	*Ryedale**	Dr. Bruce Low ...	1893
567	*St. Albans U.**	Mr. S. F. Murphy...	1884
568	St. Anne's Chapel	Dr. Blaxall ...	1881
569	St. Asaph R.	„ Parsons ...	1881
570	*St. Austell R.*	Do.	1888
571	St. George, Hanover Square†	Dr. Barry	1889
572	St. George, Hanover Square	„ Sweeting ...	1891
573	St. Helen's (Lancs.)	Mr. Spear	1882
574	St. Ives (Hunts.) R.†	Dr. Airy	1881
575	St. John's Wood†	Mr. Radcliffe ...	1872
576	*St. Joseph's Industrial School, Manchester**	Dr. Page	1888
577	*St. Mary Cray, &c. (Small-pox among Rag Sorters).*	„ Parsons ...	1881
578	*St. Pancras (printed only in annual volume)*	Mr. Power	1882
579	Sale U.	Dr. Parsons ...	1882
580	Samford R.	„ Airy	1889
581	Sandal Registration Sub-District	Mr. Sweeting ...	1885
582	*Scotter and Scotton**	Dr. Parsons ...	1890
583	Sculcoates R.	„ Blaxall ...	1877
584	Sculcoates R.*	„ Barry	1890
585	*Sedgley Registration Sub-District*	„ Ballard ...	1874
586	Seend†	Mr. Sweeting ...	1885
587	Seisdon R.	Dr. Ballard ...	1874
588	Selborne...	„ Blaxall ...	1879
589	Sevenoaks U.	„ Bruce Low ...	1896
590	Shadwell	Mr. Spear	1880
591	Shaftesbury U.	Dr. Simpson ...	1885
592	Sheerness U.†	Mr. Spear	1884
593	*Sheffield U. (Separate Volume, Small-pox Epidemic*, 1887–88).	Dr. Barry	1887
594	Shepton Mallet R.†	„ Gresswell ...	1885
595	*Sherborne U.*	„ Blaxall ...	1873
596	*Sherborne U.*	Do. ...	1882
597	Shifnal R.	Dr. Wheaton ...	1897
598	Shildon and East Thickley*	„ Bruce Low ...	1893
599	Sidmouth U.	Mr. Radcliffe ...	1877
600	*Sirhowy Valley**	„ T. W. Thompson	1895
601	Skegby and Fulwood†	Dr. Harries ...	1873
602	Skelmanthorpe U.†	„ Bruce Low ...	1889

No.	Locality Inspected.	Medical Inspector.	Year.
603	Smalley†	Dr. Page	1887
604	Southborough U.	Mr. Spear	1882
605	Southend U.	Dr. Thorne... ...	1880
606	Southend U.*	„ Bruce Low ...	1896
607	South Stoneham R.	„ Blaxall ...	1879
608	Sowerby Bridge U.	„ Parsons ...	1889
609	Spennymoor U.	Do. ...	1884
610	Spennymoor U.*	Dr. Page	1888
611	Spilsby R.	Mr. Spear	1884
612	*Staines R.**	Dr. Blaxall ...	1890
613	*Stalybridge U.*	Mr. Spear	1890
614	Standish with Langtree U.†	Dr. Page	1888
615	Stapleford	„ Thorne... ...	1877
616	Stevenage U.	Do.	1873
617	Stoke (extra urban)†	Dr. Horne	1893
618	Stoke-on-Trent Registration District ...	„ Ballard ...	1872
619	Stone R....	Do. ...	1874
620	Stourbridge Registration District	Do. ...	1873
621	Stourbridge Registration District	Dr. Parsons ...	1879
622	Stourbridge R. (Staffs. Division) *	Do. ...	1888
623	Stourbridge R. (Worcester Division)† ...	Do. ...	1888
623a	*Stow-on-the-Wold R.*	Dr. Sweeting ...	1898
624	Sunderland U.	Mr. Radcliffe ...	1871
625	Sunderland U.†	„ T. W. Thompson	1895
626	Sutton Bridge	Dr. Parsons ...	1879
627	Sutton-in-Ashfield U.	„ Harries ...	1873
628	Sutton-in-Ashfield U.	„ Parsons ...	1882
629	Sutton-in-Ashfield U.	Do. ...	1883
630	Sutton Veny	Dr. Airy	1872
631	Swanage U.	„ Home	1872
632	Swanage U*	Mr. Harvey ...	1886
633	Swanage U.*	Dr. Wheaton ...	1897
634	Swansea R. (part of)	Mr. Radcliffe ...	1875
635	Swimbridge	Dr. Ogle	1879
636	Swindon Registration Sub-District (part of)	„ Blaxall ...	1879
637	Swinton U.	„ Ballard ...	1872
637a	*Swinton and Pendlebury U.**	„ Thomson ...	1898
638	Taunton	Dr. Blaxall ...	1882
639	Tavistock R.†	Do. ...	1881
640	*Tees Valley*	Dr. Barry	1890
641	Tees Valley	Do. ...	1891
642	Tempsford†	Dr. Parsons ...	1882
643	Tenbury R.	„ Airy	1893
644	Tendring R.†	Mr. Spear	1890
645	Thirsk R†	Dr. Parsons ...	1889
646	Thorne Registration District	Do. ...	1883
647	Thorpe Saint Andrew	Dr. Copeman ...	1893
648	Thurmaston	„ Fletcher ...	1895
649	*Tichmarsh**	Mr. Power... ...	1883
650	Tideswell	Dr. Thorne ...	1876
651	Tipton U.	„ Ballard ...	1874
652	Todmorden	„ Buchanan ...	1872
653	Torpoint†	„ Ballard ...	1882
654	Totnes U. and R.	„ Parsons ...	1880
655	Tottenham U.	Mr. Radcliffe ...	1873
656	Tottenham U.	„ Sweeting ...	1885
657	Trawden U.†	„ T. W. Thompson	1891
658	Tredegar U.	„ Radcliffe ...	1878
659	Tredegar U.	„ Spear	1889

No.	Locality Inspected.	Medical Inspector.	Year.
660	*Trent River**	Dr. Bruce Low ...	1893
661	Trimdon Colliery and Trimdon Grange† ...	" Page	1884
662	Trottersclifie (*not issued*)	" Ballard ...	1879
663	Truro Registration District	" Blaxall ...	1874
664	Truro R.†	" Parsons ...	1880
665	Tudhoe, Elvet, &c., &c.	Mr. T. W. Thompson	1891
665a	Tunbridge Wells U.*	Dr. Buchanan ..	1898
666	Tynemouth Registration District*	" Barry	1883
667	Uckfield U.	Mr. Power	1881
668	Ulverston U.	" Spear	1882
669	*Upton**	Dr. Parsons ...	1889
670	*Ure River*	Mr. Sweeting ...	1885
671	Usk	Dr. Horne	1893
672	Uxbridge R.*	Mr. Evans	1893
673	Uxbridge U.†	Dr. Bruce Low ...	1889
674	Vron†	Mr. Spear	1887
675	Wadebridge*	Dr. Buchanan ...	1897
675a	Wakefield	Mr. Radcliffe ...	1871
676	Wakefield: West Riding House of Correction.	Dr. Ballard ...	1875
677	Walker U.†	" Airy	1872
678	Walsall R.†	" Thorne ...	1881
679	Walsingham R.	" Gresswell ...	1885
680	Walthamstow U.	" Airy	1888
681	Walton-on-the-Naze U.	" Parsons ...	1881
682	Walworth†	" Copeman ...	1895
683	Ware R.	" Parsons ...	1884
684	Ware U.†	" Thorne ...	1874
685	Wareham U.	" Home	1872
686	Warrington U.	" Ballard ...	1871
687	Watford U.	Mr. Sweeting ...	1885
688	Watford U. and R.	" Royle	1897
689	Wath U.†	Dr. Ballard ...	1872
690	Wednesbury U. (Registration Sub-District)	Do.	1875
691	*Welbeck*	Do.	1880
692	Wellingborough R.†	Mr. Spear	1889
693	Wellingborough U.	Dr. Thorne ...	1874
694	Wellington (Somerset) R.	" Simpson ...	1885
695	Wellington (Somerset) U.	" Blaxall ...	1872
696	Wellington (Somerset) U.	" Simpson ...	1885
697	Wells (Norfolk) Registration Sub-District (part of).†	Mr. Power	1875
698	*Wells (Norfolk) U.*	" Spear	1890
699	Wells (Somerset) R.	" Langdon ...	1879
700	West Auckland	Dr. Harries ...	1872
701	West Bromwich U.*	" Buchanan ...	1895
701a	*West Bromwich U.**	Do.	1898
702	West Bromwich U. and R.	Dr. Ballard ...	1875
703	West Cowes U.	Mr. Spear	1886
704	Weston-super-Mare U.	Dr. Blaxall ...	1882
705	Wetherby	" Thorne ...	1877
706	Whitby U. and R.	" Wilson ...	1893
707	Whitchurch (Hants.)	" Thorne ...	1872
708	Whitford Registration Sub-District ...	Mr. Power	1871
709	Whitford Registration Sub-District ...	Dr. Parsons ...	1888

No.	Locality Inspected.	Medical Inspector.	Year.
710	Whitstable	Mr. Power	1883
711	Whixley Registration Sub-District* ...	„ Sweeting ...	1885
712	Wickford	Dr. Thorne ...	1879
713	Widnes U.*	„ Bruce Low ...	1894
714	Wigan and Ince-in-Makerfield U.	„ Copeman ...	1892
715	Wigan U.	Mr. Radcliffe ...	1873
716	Wight, Isle of	Dr. Ballard ...	1880
717	Willenhall Registration Sub-District ...	Do.	1874
718	Williton R.†	Do.	1881
719	*Wimbledon U.*	Mr. Power	1886
720	Wincanton R	Dr. Home	1872
721	Wincanton R.†	„ Airy	1884
722	Wincanton R.	„ Parsons ...	1886
723	*Winchester U.*	Mr. Power	1877
724	Winchester U.	Dr. Parsons ...	1887
725	Windsor U.	„ Airy and Mr. A. Taylor.	1886
726	Windsor U.	Do.	1889
727	Wing†	Dr. Blaxall ...	1879
728	Wisbech R.	„ Page	1883
729	Witney U.	„ Fletcher ...	1897
730	Wiveliscombe U.	„ Blaxall ...	1875
731	Wolstanton and Burslem Registration District.	„ Ballard ...	1872
732	Wolverhampton U.	Do. ...	1874
733	Wombwell U.	Dr. Parsons ...	1886
734	Woolfardisworthy	„ Airy	1880
735	Woolwich U.	Mr. Spear	1884
736	Worcester U.†	Dr. Parsons ...	1889
737	Worcester U.	„ Fletcher ...	1897
738	Workington U.†	„ Page	1888
739	*Worthing**	„ Thomson ...	1893
739*a*	Wortley R.†	„ Reece	1898
740	Wrexham U.*	„ Wheaton ...	1897
741	Wrexham U. and R. (Registration District—part of).	„ Airy	1878
742	Wribbenhall	„ Thomson ...	1897
743	*Wycombe Marsh**	„ Buchanan ...	1895
744	Yateley†	Dr. Turner... ...	1886
745	Yeadon U.	Mr. Spear	1879
746	*York U.**	Dr. Airy	1884
747	*York Town and Camberley**	Mr. Power	1886
748	York Town R.	„ T. W. Thompson	1892
749	Ystradgunlais	Dr. Harries ...	1873
750	Ystradyfodwg U.† (now Rhondda) ...	„ Airy	1876

The following districts have been inspected, wholly or in part, in connexion with the inquiries in the foregoing Table, the number of which is placed against their names:—

Reference No.	District Visited.	Medical Inspector.	Year.
449	Aberavon U.	Dr. Airy	1877
516	Abersychan U.	" Ogle	1879
62	Abertillery U.	Mr. Spear	1882
63	Abertillery U.	Do. ...	1884
3	Alcester R. (part of)	Dr. Ballard ...	1875
240	Aldershot U.	Mr. Sweeting ...	1885
81	Aldershot U.	Dr. Turner ...	1886
581	Altofts U.	Mr. Sweeting ...	1885
588	Alton R.	Dr. Blaxall ...	1879
7	Alton U. and R.	Mr. Sweeting ...	1893
152	Amersham R. (part of)	" Power	1871
183	Ampthill R. (part of)	Dr. Cory	1879
10	Anglesey R.	Mr. Evans	1893
88	Astley Bridge U.	Dr. Ballard ...	1871
73	Aston	" Buchanan ...	1874
28	Atherstone R. (part of)	" Airy	1878
30	Atherton U.	Mr. Power	1877
32	Auckland R.	Dr. Thorne ...	1874
610	Auckland R.	" Page	1888
82	Axbridge R. (part of)	Mr. Power	1879
413	Axbridge R.	" T. W. Thompson	1895
35	Axminster R. (part of)	Dr. Blaxall ...	1874
670	Aysgarth R.	Mr. Sweeting ...	1885
650	Bakewell R. (part of)	Dr. Thorne ...	1876
132	Bakewell R.	" Bruce Low ...	1890
196	Bala R.	Do. ...	1895
196	Bala U.	Do. ...	1895
443	Balsall Heath U.	Dr. Ballard ...	1873
142	Bangor and Beaumaris R.	" Bruce Low ...	1895
142	Bangor U.	Do. ...	1895
235	Barlings	Dr. Gresswell ...	1885
195	Barnsley R.	" Bruce Low ...	1889
187	Barnstaple R. (part of)	" Home	1872
635	Barnstaple R.	" Ogle	1879
47	Barnstaple U. and R.	" Reece	1894
54	Barton-on-Irwell R.	" Stevens ...	1874
54	Barton-on-Irwell U.	Do. ...	1874
140	Basford R. (part of)	Dr. Harries ...	1871
203	Batley U.	" Thorne ...	1878
57	Battle R.	" Airy	1878
58	Bedale R. (part of)	Mr. Power	1877
670	Bedale R.	" Sweeting ...	1885
261	Beddgelert	Dr. Airy	1880
356	Bedford R.	Mr. Sweeting ...	1885
62	Bedwellty R.	" Spear	1882
63	Bedwellty R.	Do. ...	1884
51	Belgrave U.	Dr. Barry	1883
603	Belper R.	" Page	1887
142	Bethesda U.	" Bruce Low ...	1895
734	Bideford R.	" Airy	1880
47	Bideford U.	" Reece	1894
527	Biggleswade R.	" Parsons ...	1882
642	Biggleswade R.	Do.	1882
146	Biggleswade R.	Dr. Buchanan ...	1896
295	Biggleswade R.	Do. ...	1896

Reference No.	District Visited.	Medical Inspector.	Year.
439	Biggleswade R.	Dr. Buchanan ...	1896
712	Billericay R.	" Thorne ...	1879
71	Bilston U.	" Ballard ...	1874
203	Birkenshaw U....	" Thorne ...	1878
203	Birstall U.	Do. ...	1878
32	Bishop Auckland U.	Do. ...	1874
710	Blean R....	Mr. Power ...	1883
647	Blofield R.	Dr. Copeman ...	1893
349	Blything R.	" Mivart ...	1896
84	Bodmin U. and R.	" Parsons ...	1881
414	Bollington U.	" Thorne ...	1873
88	Bolton R.	" Ballard ...	1871
338	Bolton R.	Mr. Spear	1889
88	Bolton U.	Dr. Ballard ...	1871
310	Bosmere and Claydon R.	" Airy	1880
271	Braintree R. (part of)	" Thorne ...	1876
170	Braintree R.	" Airy	1882
156	Brampton and Walton U.	" Thorne ...	1874
213	Brandon and Byshottles U.	Mr. Spear	1881
291	Brentford R. (part of)	Dr. Thorne ...	1876
101	Bridgend R.	Mr. Spear	1888
101	Bridgend U.	Do. ...	1888
620	Brierley Hill U.	Dr. Ballard ...	1873
449	Briton Ferry U.	" Airy	1877
218	Brixworth R.	" Bruce Low ...	1889
577	Bromley R.	" Parsons ...	1881
185	Bromley R.	" Copeman ...	1894
144	Bromsgrove U. (part of)	" Ballard ...	1873
720	Bruton	" Home	1872
387	Brynmawr U. (part of)	" Harries ...	1872
385	Builth R.	" Airy	1880
731	Burslem U.	" Ballard ...	1872
121	Burton-on-Trent R. (part of)	" Airy	1878
192	Calne R.	Mr. Spear	1884
747	Camberley	" Power	1886
578	Camberwell	Do.	1882
304	Camborne U.	Dr. Ballard ...	1882
500	Cannock R. (part of)	" Airy	1876
394	Carnarvon R.	Do.	1880
142	Carnarvon R.	Dr. Bruce Low ...	1895
142	Carnarvon U.	Do. ...	1895
720	Castle Cary	Dr. Home	1872
143	Castleford U.	" Parsons ...	1880
544	Caterham	" Thorne ..	1879
352	Chard R. (part of)	" Blaxall ...	1871
270	Chelmsford R. (part of)	" Airy	1873
571	Chelsea Parish	" Barry	1889
312	Chertsey R. (part of)	" Thorne ...	1872
196	Chester R.	" Bruce Low ...	1895
196	Chester U.	Do. ...	1895
156	Chesterfield R	Dr. Thorne ..	1874
156	Chesterfield U....	Do. ...	1874
225	Chester-le-Street R. (part of)	Dr. Harries ...	1873
91	Chippenham R.	" Blaxall ...	1880
199	Chippenham R.	" Horne	1893
169	Chipping	" Airy	1880
196	Chirk R.	" Bruce Low ...	1895
156	Clay Lane U.	" Thorne ...	1874
256	Claypole R.	" Wheaton ...	1896

Reference No.	District Visited.	Medical Inspector.	Year.
424a	Claypole R.	Dr. Wheaton ...	1898
454	Clee-with-Weelsby U.	" Page	1888
380	Cliffe U.	" Thorne ...	1874
134	Clutton R.	Mr. Sweeting ...	1892
441	Coleford U	Dr. Fletcher ...	1892
142	Colwyn Bay U.	" Bruce Low ...	1895
142	Conway R.	Do. ...	1895
501	Conway R.	Do. ...	1896
142	Conway U.	Do. ...	1895
585	Coseley U.	Dr. Ballard ...	1874
101	Cowbridge U.	Mr. Spear	1888
83	Cowpen U.	Dr. Airy	1872
666	Cowpen U.	" Barry	1883
666	Cramlington U.	Do.	1883
142	Criccieth U.	Dr. Bruce Low ...	1895
387	Crickhowell R. (part of)	" Harries ...	1872
388	Crickhowell R. (part of)	" Blaxall ...	1876
646	Crowle U.	" Parsons ...	1883
59	Croydon R.	" Gresswell ...	1886
719	Croydon R.	Mr. Power ...	1886
20	Dartford R.	Mr. Power	1876
192	Dartford R.	" Spear	1884
192	Dartford U.	Do.	1884
195	Darton U.	Dr. Bruce Low ...	1889
401	Daventry R.	Do.	1896
524	Devizes R.	Dr. Copeman ...	1894
203	Dewsbury U.	" Thorne ...	1878
39	Doncaster R. (part of)	Do.	1873
504	Dore R. (part of)	Do.	1877
281	Dorking R.	Mr. Power	1882
423	Downham R.	Dr. Parsons ...	1887
156	Dronfield U.	" Thorne ...	1874
287	Droxford R.	" Parsons ...	1884
245	Dunmow R.	" Airy	1880
272	Dunmow R.	Do.	1883
610	Durham R.	Dr. Page	1888
665	Durham R.	Mr. T. W. Thompson	1891
213	Durham U. and R.	" Spear	1881
716	East Cowes U.	Dr. Ballard ...	1880
254	East Grinstead...	" Airy	1880
81	East Hampstead	" Turner ...	1886
14	East Ward R. (part of)	" Ballard ...	1873
62	Ebbw Vale U.	Mr. Spear	1882
63	Ebbw Vale U.	Do.	1884
196	Edeyrnion R.	Dr. Bruce Low ...	1895
229	Edmonton U.	Do. ...	1888
125	Edmonton U.	Dr. Copeman ...	1891
230	Edmonton U.	Do. ...	1895
384	Ely R. (part of)	Dr. Thorne ...	1873
230	Enfield U.	" Copeman ...	1895
104	Epping R. (part of)	Mr. Power... ...	1878
405	Epping R.	" Spear	1880
407	Erpingham R.	Dr. Airy	1885
434	Eston U....	" Ballard ...	1888
147	Eton R. (part of)	Mr. Power... ...	1876

Reference No.	District Visited.	Medical Inspector	Year.
304	Falmouth R.	Dr. Ballard ...	1882
304	Falmouth U. (town and parish)	Do. ...	1882
520	Fareham R. (part of)	Dr. Stevens ...	1872
237	Fareham R.	Mr. Spear	1888
237	Fareham U.	Do. ...	1888
263	Farncombe	Mr. Power	1874
578	Farnham R.	Do.	1882
240	Farnham R.	Mr. Sweeting ...	1885
21	Farnham R.	Dr. Turner ...	1886
81	Farnham R.	Do. ...	1886
255	Farnham R.	Do. ...	1886
747	Farnham R.	Mr. Power	1886
133	Farnham R.	Dr. Parsons ...	1889
240	Farnham U.	Mr. Sweeting ...	1885
88	Farnworth U.	Dr. Ballard ...	1871
618	Fenton U.	Do. ...	1872
403a	Fenton U.	Dr. Fletcher ...	1898
261	Festiniog R.	„ Airy	1880
142	Festiniog R.	„ Bruce Low ...	1895
142	Festiniog U.	Do. ...	1895
331	Flint U....	Dr. Blaxall ...	1875
46	Forehoe R.	Mr. T. W. Thompson	1894
275	Freebridge Lynn R. (part of)	Dr. Stevens ...	1877
367	Freebridge Lynn R.	„ Bruce Low ...	1892
480	Frome R. (part of)	„ Ballard ...	1872
448	Fulham Board of Works District (one institution).	Mr. Spear	1883
98	Fylde R....	Dr. Wilson... ...	1898
582	Gainsborough R.	Dr. Parsons ...	1890
660	Gainsborough R.	„ Bruce Low ..	1893
324	Gedney Drove End	„ Parsons ...	1882
582	Glanford Brigg R.	Do. ...	1890
432	Glanford Brigg R.	Dr. Bruce Low ...	1897
263	Godalming U.	Mr. Power ...	1874
347	Godmanchester U.	Dr. Parsons ...	1880
544	Godstone R.	„ Thorne ...	1879
382	Godstone R.	„ Copeman ...	1892
203	Gomersal U.	„ Thorne ...	1878
49	Grantham R.	„ Parsons ...	1890
269	Grays Thurrock U.	„ Airy	1889
553	Greasborough U.	„ Thomson ...	1891
270	Great Baddow	„ Airy	1873
454	Great Grimsby U.	„ Page	1888
670	Great Ouseburn R.	Mr. Sweeting ...	1885
711	Great Ouseburn R.	Do. ...	1885
263	Guildford R. (part of)	Mr. Power	1874
282	Guisbrough R....	Dr. Thorne ...	1875
498	Gunthwaite	Mr. Spear	1889
92	Halifax	Mr. Spear	1880
286	Halstead R.	Dr. Bruce Low ...	1889
286	Halstead U.	Do. ...	1889
281	Hambledon R.	Mr. Power	1882
618	Hanley U.	Dr. Ballard ...	1872
80	Hartley Wintney R. (part of)	„ Stevens ...	1876
81	Hartley Wintney R.	„ Turner... ...	1886
239	Hartley Wintney R.	Do. ...	1886
744	Hartley Wintney R.	Do. ...	1886

Reference No.	District Visited.	Medical Inspector.	Year.
288	Haslemere	Dr. Airy	1887
292	Hastings R.	Mr. Spear	1890
292	Hastings U.	Do. ...	1890
522	Havant R.	Dr. Thomson ...	1896
522	Havant U.	Do. ...	1896
427	Haverfordwest R.	„ Parsons ...	1880
196	Hawarden R.	„ Bruce Low ...	1895
545	Hayle U.	„ Blaxall ...	1876
304	Hayle U.	„ Ballard ...	1882
717	Heath Town U.	Do. ...	1874
302	Hebden Bridge U.	Dr. Gresswell ...	1885
447	Hebden Bridge U.	„ Page	1888
203	Heckmondwike U.	„ Thorne ...	1878
133*a*	Helston R.	„ Bruce Low ...	1898
474	Hendon	Mr. Power	1885
242	Herne Hill (Faversham R.)	Do. ...	1880
127	Hexham R. (part of)	Dr. Airy	1874
708	Holywell R.	Mr. Power	1871
331	Holywell R.	Dr. Blaxall ...	1875
709	Holywell R.	„ Parsons ...	1888
475	Holywell R.	Mr. Spear	1890
196	Holywell R.	Dr. Bruce Low ...	1895
330	Holywell R.	„ Mivart ...	1896
331	Holywell U.	„ Blaxall ...	1875
330	Holywell U.	„ Mivart... ...	1896
196	Hoole U.	„ Bruce Low ...	1895
88	Horwich U.	„ Ballard ...	1871
338	Horwich U.	Mr. Spear	1889
313	Houghton-le-Spring R. (part of)	„ Power	1874
100	Houghton-le-Spring R.	Dr. Fletcher ...	1895
314	Houghton-le-Spring R.	Do. ...	1895
666	Howden U.	Dr. Barry	1883
430	Hoxne R. (part of)	„ Airy	1873
374	Hoxne R.	„ Bruce Low ...	1894
498	Hoylandswaine U.	Mr. Spear	1889
420	Hucknall-under-Huthwaite U.	Dr. Gresswell ...	1885
346	Hull, Port of	„ Airy	1882
347	Huntingdon U. and R.	„ Parsons ...	1880
47	Ilfracombe U.	Dr. Reece	1894
714	Ince-in-Makerfield U.	„ Copeman ...	1892
88	Kearsley U.	Dr. Ballard ...	1871
355	Keighley R.	„ Stevens ...	1875
355	Keighley U.	Do. ...	1875
92	Keighley U.	Mr. Spear	1880
571	Kensington Parish	Dr. Barry	1889
120	Kettering R. (part of)	„ Thorne ...	1872
742	Kidderminster R.	„ Thomson ...	1897
731	Kidsgrove U.	„ Ballard ...	1872
443	King's Norton R. (part of)	Do. ...	1873
370	Knighton R.	Dr. Airy	1878
370	Knighton U.	Do. ...	1878
258	Lancaster R.	Dr. Barry	1882
17	Leeds U. (part of)	„ Ballard ...	1872
377	Leigh U. (part of)	Mr. Power	1872
727	Leighton Buzzard R.	Dr. Blaxall ...	1879

Reference No.	District Visited.	Medical Inspector.	Year.
383	Leighton Buzzard R.	Dr. Bulstrode ...	1894
380	Lewes U. and R.	„ Thorne ...	1874
279	Lexden and Winstree R.	„ Copeman ...	1893
670	Leyburn R.	Mr. Sweeting ...	1885
235	Lincoln R.	Dr. Gresswell ...	1885
469	Lincoln R. (one house)	Do. ...	1885
88	Little Hulton U.	Dr. Ballard ...	1871
88	Little Lever U....	Do. ...	1871
203	Liversedge U.	Dr. Thorne ...	1878
329	Llandausaint Registration Sub-District ...	„ Ogle	1879
392	Llandilofawr R.	„ Sweeting ...	1895
142	Llandudno R.	„ Bruce Low ...	1895
142	Llanfairfechan U.	Do. ...	1895
396	Llanfyllin R.	Dr. Parsons ...	1888
196	Llangollen R.	„ Bruce Low ...	1895
196	Llangollen U.	Do. ...	1895
142	Llanrwst R.	Do. ...	1895
400	Loddon and Clavering R.	Dr. Sweeting ...	1894
15	London, Port of	Mr. Power	1880
176	London, Port of	Do. ...	1881
618	Longton U.	Dr. Ballard ...	1872
18	Lutterworth R.	Mr. Spear	1887
414	Macclesfield R. (part of)	Dr. Thorne... ...	1873
669	Macclesfield R....	„ Parsons ...	1889
669	Macclesfield U....	Do. ...	1889
415	Machynlleth R.	Dr. Airy	1876
101	Maesteg U.	Mr. Spear	1888
662	Malling R.	Dr. Ballard ...	1879
481	Malmesbury R.	„ Downes ...	1883
106	Malmesbury R....	„ Bruce Low ...	1890
196	Malpas R.	Do. ...	1895
576	Manchester U. (one institution)	Dr. Page	1888
601	Mansfield R. (part of)	„ Harries ...	1873
420	Mansfield R.	„ Gresswell ...	1885
691	Mansfield U.	„ Ballard ...	1880
126	Maresfield (Uckfield R.)	„ Airy	1887
575	Marylebone, St. (part of)	Mr. Radcliffe ...	1872
670	Masham U.	„ Sweeting ...	1885
586	Melksham R.	Do. ...	1885
142	Menai Bridge U.	Dr. Bruce Low ...	1895
719	Merton	Mr. Power	1886
582	Messingham	Dr. Parsons ...	1890
143	Methley U.	Do. ...	1880
447	Midgley U.	Dr. Page	1888
411	Midhurst R.	„ Airy	1880
720	Milborne Port	„ Home	1872
371	Mildenhall R.	„ Copeman ...	1892
203	Mirfield U.	„ Thorne ...	1878
331	Mold U....	„ Blaxall ..	1875
196	Mold U....	„ Bruce Low ...	1895
204	Monmouth R.	Mr. Spear	1888
441	Monmouth R.	Dr. Fletcher ...	1892
441	Monmouth U.	Do. ...	1892
203	Morley U.	Dr. Thorne ...	1878
517	Mountain Ash U.	„ Airy	1876
518	Mountain Ash U.	Mr. Spear	1889
357	Mutford and Lothingland R.	Dr. Bruce Low ...	1896

Reference No.	District Visited.	Medical Inspector	Year.
386	Narberth R.	Mr. Spear	1888
449	Neath U. and R.	Dr. Airy	1877
660	Newark U.	„ Bruce Low ...	1893
156	Newbold-cum-Dunston U.	„ Thorne ...	1874
618	Newcastle-under-Lyme U. (part of) ...	„ Ballard ...	1872
350	New Forest R.	„ Bulstrode ...	1894
682	Newington U.	„ Copeman ...	1895
191	Newmarket R.	„ Turner... ...	1886
445	Newmarket R.	Do. ...	1886
716	Newport (I. W.)	Dr. Ballard ...	1880
282	Normanby U.	„ Thorne... ...	1875
434	Normanby U.	„ Ballard ...	1888
581	Normanton U.	Mr. Sweeting ...	1885
540	Northampton R.	Dr. Bruce Low ...	1891
70	North Bierley U. (part of)	„ Thorne... ...	1874
503	Northfleet U. (part of)	Do. ...	1871
178	Norwich U.	Dr. Airy	1888
116	Nottingham U. (part of)	„ Harries ...	1871
534	Nottingham U....	„ Thorne... ...	1872
378	Nottingham U.	Do.	1875
145	Oakley, Brome, Scole, &c.	Dr. Bruce Low ...	1890
355	Oakworth U.	„ Stevens ...	1875
101	Ogmore and Garw U....	Mr. Spear	1888
473	Okehampton R.	Dr. Blaxall ...	1881
485	Oldham R.	„ Stevens ...	1875
89	Ongar U.	„ Airy	1881
282	Ormesby U.	„ Thorne ...	1875
434	Ormesby U.	„ Ballard ...	1888
493	Orrell	„ Airy	1880
33	Orsett R.	Mr. Spear	1880
269	Orsett R.	Dr. Airy	1889
203	Osset-cum-Gawthorpe U.	„ Thorne ...	1878
196	Oswestry R.	„ Bruce Low ...	1895
196	Overton R.	Do.	1895
456	Oxford U. (part of)	Dr. Thorne ...	1872
516	Panteg U.	Dr. Ogle	1879
418	Pembroke R.	„ Airy	1880
498	Penistone R.	Mr. Spear	1889
498	Penistone U.	Do.	1889
142	Penmaenmawr U.	Dr. Bruce Low ...	1895
304	Penryn U.	„ Ballard ...	1882
545	Phillack U.	„ Blaxall ...	1876
304	Phillack U.	„ Ballard ...	1882
148	Plymouth U. (part of)	„ Home	1872
424	Pocklington R.	Mr. Royle	1885
749	Pontardawe R. (part of)	Dr. Harries ...	1873
515	Pontefract R. (part of)	„ Beard	1875
516	Pontypool U.	„ Ogle	1879
517	Pontypridd R.	„ Airy	1876
518	Pontypridd R.	Mr. Spear	1889
517	Pontypridd U.	Dr. Airy	1876
518	Pontypridd U.	Mr. Spear	1889
618	Pool's Dam	Dr. Ballard ...	1872
525	Potterspury R....	„ Bulstrode ...	1895
142	Pwllheli R.	„ Bruce Low ...	1895
142	Pwllheli U.	Do.	1895

Reference No.	District Visited.	Medical Inspector.	Year.
620	Quarry Bank U.	Dr. Ballard ...	1873
51	Quorndon U.	„ Barry	1883
203	Ravensthorpe U.	Dr. Thorne ...	1878
553	Rawmarsh U.	„ Thomson ...	1891
282	Redcar U.	„ Thorne ...	1875
304	Redruth R.	„ Ballard ...	1882
133a	Redruth R.	„ Bruce Low ...	1898
304	Redruth U.	„ Ballard ...	1882
545	Redruth U. and R.	„ Blaxall ...	1876
544	Reigate U.	„ Thorne ...	1879
750	Rhondda	„ Bruce Low ...	1893
670	Ripon R.	Mr. Sweeting ...	1885
670	Ripon U.	Do. ...	1885
43	Romford R. (part of)	Dr. Harries ...	1873
44	Romford R. (part of)	„ Buchanan ...	1873
45	Romford R.	„ Thorne ...	1880
536	Romford R.	Mr. Evans	1894
553	Rotherham U.	Dr. Thomson ...	1891
485	Royton U.	„ Stevens ...	1875
236	Rusholme U.	„ Airy	1879
395	Ruthin R. (part of)	„ Thorne ...	1877
196	Ruthin R.	„ Bruce Low ...	1895
716	Ryde (I.W.)	„ Ballard ...	1880
585	Saffron Walden R. (part of)	Mr. Power	1877
567	St. Albans R.	„ S. F. Murphy...	1884
266	St. Austell R. (part of)	Dr. Corfield ...	1871
457	St. Columb Major R. (part of)	„ Blaxall ...	1877
458	St. Columb Major R.	„ Ballard ...	1880
675	St. Columb Major R.	„ Buchanan ...	1897
178	St. Faiths R.	„ Airy	1888
578	St. George, Hanover Square	Mr. Power	1882
437	St. Germans R....	Dr. Ballard ...	1880
438	St. Germans R....	Do. ...	1882
653	St. Germans R....	Do. ...	1882
578	St. Giles, Bloomsbury...	Mr. Power	1882
716	St. Helens (I.W.)	Dr. Ballard ...	1880
361	St. John's Wood	Mr Power	1878
578	St. Martin-in-the-Fields	Do.	1882
581	Sandal Magna U.	Mr. Sweeting ..	1885
716	Sandown U.	Dr. Ballard ...	1880
346	Sculcoates R.	„ Airy	1882
661	Sedgefield R.	„ Page	1884
585	Sedgley, Upper, U.	„ Ballard ...	1874
666	Seghill U.	„ Barry	1883
444	Shaftesbury R....	„ Simpson ...	1885
716	Shanklin U.	„ Ballard ...	1880
209	Shardlow R. (part of)	„ Beard	1872
615	Shardlow R. (part of)	„ Thorne ...	1877
137	Shipston-on-Stour R. (part of)	„ Harries ...	1873
95	Shipston-on-Stour R. (part of)	Mr. Power	1876
717	Short Heath U.	Dr. Ballard ...	1874
327	Silloth (Holme Cultram)	„ Parsons ...	1888
282	Skelton U.	„ Thorne ...	1875
203	Soothill, Nether, U.	Do. ...	1878
203	Soothill, Upper, U.	Do. ...	1878
83	South Blyth U.	Dr. Airy	1872
666	South Blyth and Newsham	„ Barry	1883

Reference No.	District Visited.	Medical Inspector.	Year.
164	South Molton R. (part of)	Dr. Home	1872
447	Sowerby U.	„ Page	1888
207	Spalding R.	Do.	1883
208	Spalding R.	Do.	1884
32	Spennymoor U.	Dr. Thorne ...	1874
270	Springfield	„ Airy	1873
683	Stanstead Abbots	„ Parsons ...	1884
498	Stocksbridge U.	Mr. Spear	1889
618	Stoke-on-Trent R.	Dr. Ballard ...	1872
618	Stoke-on-Trent U.	Do. ...	1872
620	Stourbridge R.	Do. ...	1873
181	Stourbridge R.	Dr. Gresswell ...	1889
620	Stourbridge U....	„ Ballard ...	1873
90	Stow-on-the-Wold R.	Do. ...	1874
172	Stratford-on-Avon R. (part of)	Do. ...	1873
362	Stratton R.	Dr. Parsons ...	1888
54	Stretford U.	„ Stevens ...	1874
420	Sutton-in-Ashfield U....	„ Gresswell ...	1885
121	Swadlincote U....	„ Airy	1878
451	Swaffham R. (part of)	Do.	1876
636	Swindon, New, U.	Dr. Blaxall ...	1879
636	Swindon, Old, U.	Do. ...	1879
54	Swinton and Pendlebury U.	Dr. Stevens ...	1874
196	Tarvin R.	Dr. Bruce Low ...	1895
74	Taunton R.	„ Blaxall ...	1882
131	Tavistock R. (part of)	Do. ...	1876
284	Tavistock R	Do. ...	1881
568	Tavistock R.	Do. ...	1881
69	Tenterden R.	Dr. Thorne ...	1879
276	Thame R. (part of)	Do. ...	1872
646	Thorne R.	Dr. Parsons ...	1883
660	Thorne R.	„ Bruce Low ...	1893
203	Thornhill U.	„ Thorne ...	1878
538	Thrapston R.	„ Airy	1880
649	Thrapston R.	Mr. Power ...	1883
540	Thrapston R.	Dr. Bruce Low ...	1891
539	Thrapston R.	Do. ...	1895
498	Thurlstone R.	Mr. Spear	1889
51	Thurmaston U.	Dr. Barry	1883
302	Todmorden R.	„ Gresswell ...	1885
447	Todmorden R.	„ Page	1888
406	Totnes R.	„ Blaxall ...	1888
415	Towyn U.	„ Airy	1876
663	Truro U. and R.	„ Blaxall ...	1874
731	Tunstall U.	„ Ballard ...	1872
88	Turton U.	Do. ...	1871
214	Turton U. (part of)	Mr. Power ...	1876
30	Tyldesley-cum-Shakerley U....	Do. ...	1877
83	Tynemouth R. (part of)	Dr. Airy	1872
363	Tynemouth R. (part of)	Do. ...	1872
400	Tynemouth R.	Dr. Sweeting ...	1894
455	Tynemouth R.	Do. ...	1894
666	Tynemouth U. and R.	Dr Barry	1883
126	Uckfield R.	Dr. Airy	1887
196	Uwchaled R.	„ Bruce Low ...	1895
477	Uxbridge R.	Mr. Power	1882

Reference No.	District Visited.	Medical Inspector.	Year.
716	Ventnor U.	Dr. Ballard ...	1880
581	Wakefield R.	Mr. Sweeting ...	1885
666	Walker U.	Dr. Barry	1883
453	Wallasey U.	Mr. Spear	1888
666	Wallsend U.	Dr. Barry	1883
697	Walsingham R. (part of)	Mr. Power	1875
166	Wandsworth Board of Works District ...	Dr. Parsons ...	1882
528	Wandsworth Board of Works District ...	" Blaxall ...	1883
63)	Warminster R. (part of)	" Airy	1872
336	Warminster R. (part of)	Mr. Power ...	1876
717	Wednesfield U.	Dr. Ballard ...	1874
316	Wellingborough R. (part of)	" Home ...	1871
224	Wellingborough R. (part of)	" Buchanan ...	1872
716	West Cowes U.	" Ballard ...	1880
88	West Houghton U.	Do. ...	1871
338	West Houghton U.	Mr. Spear ...	1889
705	Wetherby R. (part of)	Dr. Thorne... ...	1877
590	Wetherby U.	Mr. Spear	1880
324	Whaplode Drove	Dr. Parsons ...	1882
707	Whitchurch (Hants) R. (part of)	" Thorne ...	1872
196	Whitchurch (Salop) U.	" Bruce Low ...	1895
666	Whitley and Monkseaton, U.	" Barry	1883
156	Whittington U.	" Thorne ...	1874
143	Whitwood, U.	" Parsons ...	1880
714	Wigan U.	" Copeman ...	1892
716	Wight, Isle of, R.	" Ballard ...	1880
460	Wight, Isle of, R.	" Thomson ...	1894
717	Willenhall U.	" Ballard ...	1874
666	Willington Quay U.	" Barry	1883
720	Wincanton	" Home	1872
532	Wincanton R.	" Parsons ...	1888
19	Windsor R. (part of)	" Ballard ...	1877
271	Witham R. (part of)	" Thorne ...	1876
232	Woburn R.	" Parsons ...	1884
731	Wolstanton and Burslem R.	" Ballard ...	1872
691	Worksop U.	Do. ...	1880
674	Wrexham R.	Mr. Spear	1887
196	Wrexham R.	Dr. Bruce Low ...	1895
196	Wrexham U.	Do. ...	1895
743	Wycombe R.	Dr. Buchanan ...	1895
280	Yarmouth U.	Dr. Airy	1875
576	York U.	" Page	1888
133	York Town	" Parsons ...	1889
515	Ystradyfodwg U.	" Airy	1876
514	Ystradyfodwg U.	" Parsons ...	1880

CHOLERA (SANITARY) SURVEY, 1885–86.

ALPHABETICAL LIST of DISTRICTS INSPECTED.

Name of District.	Urban, Rural or Port.	Date of Report.	Name of Inspector.
Aberavon	U.	August, 1885 ...	Dr. Davies.
Abertilling	U.	June, 1886 ...	Mr. Spear.
Aberystwith	U.	January, 1886 ...	Dr. Davies.
Abram	U.	December, 1886.	„ Parsons.
Accrington	U.	September, 1886	„ Page.
Alnwick	R.	October, 1885 ...	Do.
Alnwick and Canongate ...	U.	Do. ...	Do.
Altofts	U.	October, 1886 ...	Mr. Spear.
Alvaston and Boulton ...	U.	May, 1886 ...	Do.
Alverstoke	U.	July, 1885 ...	Do.
Amble	U	June, 1885 ...	Dr. Page.
Arundel	U.	September, 1885	Mr. Spear.
Ashton-in-Makerfield ...	U.	November, 1886	Dr. Parsons.
Ashton-under Lyne	U.	September, 1886	„ Page.
Aspull	U.	November, 1886	„ Parsons.
Atcham	R.	June, 1886 ...	Mr. Spear.
Auckland	R.	April, 1885 ...	Dr. Page.
Austonley	U.	January, 1887 ...	„ Gresswell.
Bangor ... ... } Beaumaris ... ... }	U.	December, 1885.	Dr. Davies.
Barnard Castle	U.	May, 1885 ...	„ Page.
Barnsley	U.	November, 1886	Mr. Spear.
Barnsley	R.	December, 1886.	Do.
Barnstaple	U.	July, 1885 ...	Dr. Davies.
Barnstaple	R.	Do. ...	Do.
Barrow-in-Furness	U.	August, 1885 ...	Dr. Blaxall.
Batley	U.	September, 1886	„ Barry.
Bedlingtonshire	U.	June, 1885 ...	„ Page.
Belford	R.	September, 1885	Do.
Bedwellty	R.	June, 1886 ...	Mr. Spear.
Benfieldside	U.	November, 1886	Dr. Page.
Benwell and Fenham ...	U.	October, 1885 ...	Do.
Bermondsey	U.	March, 1885 ...	Dr. de Chaumont.
Berwick on-Tweed	U.	Do. ...	Do.
Berwick-on-Tweed	U.	June, 1885 ...	Dr. Page.
Berwick-on-Tweed	P.	Do. ...	„ de Chaumont.
Berwick-on-Tweed	R.	September, 1885	„ Page.
Bideford	U.	July, 1885 ...	„ Davies.
Bideford	R.	Do. ...	Do.
Billinge	U.	December, 1886.	Dr. Parsons.
Bilston	U.	July, 1886 ...	„ Barry.
Birkdale	U.	October, 1886 ...	„ Parsons.
Birkenhead	U.	May, 1885 ...	„ Blaxall.
Birkenshaw	U.	November, 1885	„ Barry.
Birstal	U.	November, 1886	Do.
Bishop Auckland	U.	November, 1885	Dr. Page.
Blackburn	U.	November, 1886	Do.
Blackpool	U.	December, 1885.	Do.

Name of District.	Urban, Rural or Port.	Date of Report.	Name of Inspector.
Blackrod	U.	November, 1886	Dr. Parsons.
Blean	R.	March, 1885 ...	„ de Chaumont.
Bodmin	R.	May, 1885 ...	„ Davies.
Bognor	U.	July, 1885 ...	Mr. Spear.
Bolton	R.	May, 1886 ...	Dr. Page.
Bootle	U.	May, 1885 ...	„ Blaxall.
Boston	U.	November, 1886	Dr. Airy.
Boston	P.	August, 1885 ...	Do.
Brampton and Walton ...	U.	June, 1886 ...	Mr. Spear.
Brandon and Byshottles ...	U.	December, 1885	Dr. Page.
Bridgend	U.	October, 1885 ...	Dr. Davies.
Bridgend	R.	Do. ...	Do.
Bridgend	R.	April, 1886 ...	Do.
Bridgwater	U.	January, 1885 ..	Dr. Blaxall.
Bridgwater	P.	Do. ...	Do.
Bridlington	U.	August, 1886 ...	Dr. Airy.
Bridlington	R.	January, 1887 ...	Dr. Davies.
Bridport	U.	February, 1885	Do.
Bridport	R.	January, 1887 ...	Do.
Brierley Hill	U.	May, 1886 ...	Dr. Gresswell.
Bristol	U.	January, 1885...	Dr. Blaxall.
Bristol	P.	Do. ...	Do.
Briton Ferry	U.	August, 1885 ...	Dr. Davies.
Broadstairs	U.	January, 1885 ...	Do.
Bromborough	U.	July, 1886 ...	Mr. Spear.
Brynmawe	U.	March, 1886 ...	Do.
Budleigh Salterton	U.	August, 1885 ...	Do.
Bulkington	U.	September, 1886	Do.
Burnley	U.	October, 1886 ...	Dr. Page.
Burslem	U.	September, 1886	Dr. Barry.
Bury	U.	Do. ...	Dr. Page.
Calne	U.	August, 1886 ...	Mr. Spear.
Calne	R.	Do. ...	Do.
Cambridge	U.	December, 1885	Dr. Airy.
Camelford	R.	July, 1885 ...	„ Davies.
Cardiff	U.	Do. ...	„ Blaxall.
Cardiff	P.	Do. ...	Do.
Cardigan	U.	January, 1886 ...	Dr. Davies.
Cardigan	P.	Do. ...	Do.
Carlisle	U.	August, 1885 ...	Dr. Blaxall.
Castleford	U.	October, 1886 ...	Mr. Spear.
Carmarthen	U.	October 1885 ...	Dr. Davies.
Carmarthen	R.	November, 1885	Do.
Carnarvonshire	Combd.	December, 1885	Do.
Carnarvon	U.	Do. ...	Do.
Carnarvon	P.	Do. ...	Do.
Carnarvon	R.	August, 1886 ...	Mr. Spear.
Castle Ward	R.	October, 1885 ...	Dr. Page.
Chard	U.	May, 1885 ...	Mr. Spear.
Chard	R.	Do. ...	Do.
Chepstow	U.	February, 1885	Dr. Blaxall.
Chepstow	P.	Do. ...	Do.
Chester	U.	October, 1886 ...	Dr. Page.
Chester	P.	January, 1886 ...	Do.
Chesterfield	U.	June, 1886 ...	Mr. Spear.

Name of District.	Urban, Rural or Port.	Date of Report.	Name of Inspector.
Chesterfield	R.	June 1886 ...	Mr. Spear.
Chester le Street	U.	January, 1886...	Dr. Page.
Chesterton	U.	June, 1885 ...	Mr. Spear.
Chesterton	R.	May, 1885 ...	Do.
Chatham	U.	March, 1885 ...	Dr. de Chaumont.
Chichester	U.	June, 1885 ...	Mr. Spear.
Chailey...	R.	December, 1885	Do.
Chilvers Coton	U.	July, 1886 ...	Do.
Chippenham	U.	August, 1886 ...	Do.
Chippenham	R.	Do. ...	Do.
Chorley (Cheshire)	U.	May, 1885 ...	Dr. Airy.
Chorley...	U.	November, 1886	„ Page.
Clay Lane	U.	June, 1886 ...	Mr. Spear.
Clayton West	U.	February, 1887..	Dr. Gresswell.
Cleethorpes with Thrumscoe	U.	May, 1886 ...	„ Airy.
Cockermouth	U.	August, 1885 ...	„ Page.
Colchester	U.	January, 1886...	„ Airy.
Colchester	P.	October, 1885 ...	Do.
Colchester (Maldon)	P.	Do. ...	Do.
Colne Valley Combination ...	...	January, 1887...	Dr. Gresswell.
Consett	U.	October. 1886 ...	„ Page.
Conway	U.	December, 1885..	„ Davies.
Coseley	U.	July, 1886 ...	„ Gresswell.
Cowes	P.	March, 1886 ...	„ Davies.
Cowpen	U.	June, 1885 ...	„ Page.
Crediton	U.	April, 1885 ...	Mr. Spear.
Crediton	R.	Do. ...	Do.
Crickhowell	R.	March, 1886 ...	Do.
Crowle	U.	January, 1886 ...	Do.
Cumberworth	U.	Jannary, 1887 ..	Dr. Gresswell.
Darlaston	U.	August, 1886 ...	Dr. Barry.
Darlington	U.	March, 1885 ...	„ Page.
Darlington	R.	Do. ...	Do.
Dartford	U.	June, 1885 ...	Mr. Spear.
Dartford	R.	Do. ..	Do.
Dartmouth	U.	March, 1885 ...	Dr. Davies.
Darton	U.	December. 1886..	Mr. Spear.
Deal	P.	August, 1884 ...	Dr. de Chaumont.
Deal	U.	January, 1885 ...	„ Davies.
Denby Dale	U.	February, 1887...	„ Gresswell.
Deptford	U.	Do ...	.. de Chaumont.
Derby	U.	August. 1886 ...	Mr. Spear.
Devonport	U.	June, 1885 ...	Dr. Blaxall.
Dewsbury	U.	December, 1886..	.. Barry.
Dodworth	U.	Do. ...	Mr. Spear.
Dorchester	R.	March, 1885 ...	Dr. Davies.
Dover	P.	August, 1884 ...	„ de Chaumont.
Dover	P.	January, 1885 ...	„ Davies.
Dover	P.	Do. ...	Do.
Driffield	R.	December, 1886..	Dr. Airy.
Dronfield	U.	June, 1886 ...	Mr. Spear.
Dudley	U.	March, 1885 ...	Dr. Barry.
Durham	U.	January, 1886 ..	„ Page.
Durham	R.	Do. ...	Do.
Easington	R.	February, 1885 ..	Dr. Page.
East Cowes	U.	May, 1885 ...	„ Blaxall.

Name of District.	Urban, Rural or Port.	Date of Report.	Name of Inspector.
East Preston	R.	November, 1885..	Mr. Spear.
East Stonehouse	U.	June, 1885 ...	Dr. Blaxall.
Ebbw Vale	U.	April, 1886 ...	Mr. Spear.
Elland	U.	November, 1886..	Dr. Parsons.
Erith	U.	February, 1885..	„ de Chaumont.
Exeter	U.	September, 1885	Mr. Spear.
Exeter Port	P.	March, 1885 ...	Dr. Davies.
Exmouth	U.	Do. ...	Do.
Falmouth	U.	March, 1885 ...	Dr. Davies.
Falmouth and Truro Port ...	P.	Do. ...	Do.
Fareham	U.	September, 1885	Mr. Spear.
Fareham	R.	August, 1885 ...	Do.
Farnley Tyas	U.	February, 1887..	Dr. Gresswell.
Faversham	U. & P.	March, 1885 ...	„ de Chaumont.
Featherstone	U.	November, 1886..	Mr. Spear.
Fenton	U.	September, 1886	Dr. Barry.
Festiniog	U.	June, 1886 ...	Mr. Spear.
Festiniog	R.	April, 1886 ...	Do.
Fleetwood	U.	August, 1885 ...	Dr. Blaxall.
Fleetwood	P.	Do. ...	Do.
Flegg (East and West) ...	R.	February, 1887..	Dr. Gresswell.
Flint	U.	June, 1885 ...	„ Davies.
Folkestone	U.	January, 1885...	Do.
Fulstone	U.	„ 1887...	Dr. Gresswell.
Gainsborough...	U.	April, 1885 ...	Dr. Airy.
Gainsborough...	R.	June, 1885 ...	Do.
Garston	U.	June, 1886 ...	Dr. Page.
Gateshead	U.	February, 1886 .	Do.
Gillingham	U.	March, 1885 ...	Dr. de Chaumont.
Gloucester	U.	January 1885 ...	„ Blaxall.
Gloucester	P.	Do. ...	Do.
Godmanchester	U.	May, 1885 ...	Mr. Spear.
Golcar	U.	January, 1887 ...	Dr. Gresswell.
Gomersal	U.	November, 1886.	„ Barry.
Goole	U.	March, 1885 ..	„ Blaxall.
Goole	R.	September, 1886.	Mr. Spear.
Gorton	U.	March, 1886 ...	Dr. Page.
Gower	R.	November, 1885.	„ Davies.
Gravesend	U.	February, 1885..	„ de Chaumont.
Greasborough..	U.	December, 1886.	Mr. Spear.
Great Grimsby	U. & P.	March, 1885 ...	Dr. Blaxall.
Greenwich	U.	February, 1885..	„ de Chaumont.
Guisborough	U.	December, 1885.	Mr. Spear.
Guisborough	R.	Do. ...	Do.
Gunthwaite & Ingbirchworth	U.	February, 1887.	Dr. Gresswell.
Halifax	R.	December, 1886.	Dr. Parsons.
Hanley...	U.	August, 1886 ...	„ Barry.
Hardington	U.	July, 1886 ...	Mr. Spear.
Hardingstone	R.	September, 1886	Do.
Harrington	U.	August, 1885 ...	Dr. Blaxall.
Hartlepool	U.	February, 1885.	Do.
Hartlepool	R.	June, 1885 ...	Dr. Page.
Harwich	U.	June, 1886 ...	„ Airy.

Name of District.	Urban, Rural or Port.	Date of Report.	Name of Inspector.
Harwich	P.	October, 1885 ...	Dr. Airy.
Haslingden	U.	September, 1886.	„ Page.
Havant	U.	September, 1885.	Mr. Spear.
Havant	R.	September, 1885.	Do.
Haverfordwest	U.	September, 1885.	Dr. Davies.
Haverfordwest	R.	Do. ...	Do.
Hayle	U.	July, 1885 ...	Do.
Heath Town	U.	July, 1886 ...	Dr. Barry.
Heckmondwike	U.	November, 1886.	Do.
Helston	R.	July, 1885 ...	Dr. Davies.
Hemsworth	R.	April, 1885 ...	„ Airy.
Hepworth	U.	January, 1887 ...	„ Gresswell.
Herne Bay	U.	January, 1885 ...	„ Davies.
Heywood	U.	October, 1886 ...	„ Page.
Higher Bebington	U.	July, 1886 ...	Mr. Spear.
Hinderwell	U.	December, 1885.	Do.
Holme Cultram	U.	August, 1885 ...	Dr. Blaxall.
Holme Valley Combination ...	...	January, 1887 ...	„ Gresswell.
Holmfirth	U.	Do. ...	Do.
Holme	U.	Do. ...	Do.
Holyhead	U.	December, 1885.	Dr. Davies.
Holywell	U.	June, 1885 ...	Do.
Holywell	R.	Do. ...	Do.
Honley	U.	January, 1887...	Dr. Gresswell.
Horwich	U.	December, 1886.	„ Parsons.
Hoo	R.	March, 1885 ...	„ de Chaumont.
Houghton le Spring	U.	Do. ...	„ Page.
Houghton le Spring	R.	Do. ...	Do.
Howden	R.	June, 1885 ...	Dr. Airy.
Hoylandswaine	U.	February, 1887..	„ Gresswell.
Huddersfield Combinations ...	...	January, 1887...	Do.
Hull	U.	March, 1886 ...	„ Page.
Hull and Goole	P.	August, 1885 ...	„ Blaxall.
Huntingdon	U.	May, 1885 ...	Mr. Spear.
Huntingdon	R.	Do. ...	Do.
Hythe	U.	January, 1885...	Dr. Davies.
Ilfracombe	U.	July, 1885 ...	Dr. Davies.
Ince in Makerfield	U.	October, 1886 ...	„ Parsons.
Ipswich	U.	June, 1886 ...	„ Airy.
Ipswich	P.	Do. ...	Do.
Jarrow	U.	March, 1885 ...	Dr. de Chaumont.
Keighley	U.	April, 1886 ...	Dr. Barry.
Kettering	U.	July, 1886 ...	Mr. Spear.
Kettering	R.	Do. ...	Do.
Kidsgrove	U.	September, 1886	Dr. Barry.
Kingsbridge	R.	March, 1885 ...	„ Davies.
Kings Lynn	P.	August, 1885 ...	„ Airy.
Kirk Burton	U.	February, 1887..	„ Gresswell.
Kirkheaton	U.	Do ...	Do.
Kirkleatham	U.	December, 1885.	Mr. Spear.

Name of District.	Urban, Rural or Port.	Date of Report.	Name of Inspector.
Lancaster	U.	August, 1885 ...	Dr. Blaxall.
Lancaster Port	P.	Do. ...	Do.
Lanchester	R.	November, 1885	Dr. Page.
Lathom	U.	April, 1886 ...	Do.
Leadgate	U.	October, 1886 ...	Do.
Lepton	U.	February, 1887..	Dr. Gresswell.
Lewes	U.	November, 1885	Mr. Spear.
Lexden	R.	May, 1886 ...	Dr. Airy.
Limehouse	U.	February, 1885..	„ de Chaumont.
Lincoln...	U.	October, 1886 ...	„ Airy.
Linthwaite	U.	January, 1887...	„ Gresswell.
Liskeard	R.	April, 1885 ...	„ Davies.
Littlehampton	U.	July, 1885 ...	Mr. Spear.
Liverpool	U.	May, 1885 ...	Dr. Blaxall.
Liverpool	P.	April, 1885 ...	Do.
Liversedge	U.	November, 1886	Dr. Barry.
Llanelly	U.	August, 1885 ...	„ Davies.
Llanelly	R.	Do. ...	Do.
Loftus	U.	December, 1885.	Mr. Spear.
London...	P.	February, 1885..	Dr. de Chaumont.
Long Eaton	U.	June, 1886 ...	Mr. Spear.
Longton	U.	September, 1886	Dr. Barry.
Longwood	U.	January, 1887...	„ Gresswell.
Lower Bebington	U.	July, 1885 ...	Mr. Spear.
Lower Brixham	U.	March, 1885 ...	Dr. Davies.
Lowestoft	P.	November, 1885	„ Airy.
Lyme Regis	U.	March, 1886 ...	Dr. Davies.
Lytham	U.	August, 1885 ...	„ Blaxall.
Lytham	P.	Do. ...	Do.
Macclesfield	U.	August, 1886 ...	Dr. Page.
Maesteg	U.	October, 1885 ...	„ Davies.
Maidstone	U.	March, 1885 ...	Mr. Spear.
Maidstone	R.	Do. ...	Do.
Maldon	U.	January, 1887...	Dr. Airy.
Maldon	R.	Do. ...	Do.
Malling	R.	March, 1885 ...	Mr. Spear.
Malton	U.	December, 1885	Do.
Malton	R.	Do. ...	Do.
Margam	U.	September, 1885	Dr. Davies
Margate	U.	January, 1885 ...	Do.
Marsden	U.	January, 1887 ...	Dr. Gresswell.
Maryport	U.	August, 1885 ...	„ Blaxall.
Meltham	U.	January, 1887 ...	„ Gresswell.
Merthyr Tydfil	U.	September, 1885	„ Ballard.
Methley	U.	November, 1886	Mr. Spear.
Mexborough	U.	December, 1886	Do.
Middlesbrough	U.	June, 1885 ...	Do.
Middlewich	U.	August, 1886 ...	Do.
Milford	U.	August, 1885 ...	Dr. Davies.
Milford Port	P.	October, 1885 ...	Do.
Millom	U.	August, 1885 ...	Dr. Blaxall.
Milton	U. & R.	Do. ...	„ de Chaumont.
Mirfield	U.	November, 1886	„ Barry.
Mold	U.	June, 1885 ...	„ Davies.
Monk Bretton...	U.	December, 1886	Mr. Spear.
Morecambe	U.	December, 1885	Dr. Page.

Name of District.	Urban, Rural or Port.	Date of Report.	Name of Inspector.
Morley	U.	November, 1886	Dr. Barry.
Morpeth	U.	August, 1885...	„ Page.
Morpeth	R.	June, 1885 ...	Do.
Mossley	U.	October, 1886 ...	Dr. Gresswell.
Moss-side	U.	March, 1886 ...	„ Page.
Mountain Ash	U.	May, 1885 ...	„ Davies.
Narberth	R.	November, 1885	Dr. Davies.
Neath	U.	August, 1885 ...	Do.
Neath	R.	October, 1885 ...	Do.
Neath	R.	April, 1886 ...	Do.
Neston and Parkgate ...	U.	July, 1886 ..	Mr. Spear.
Netherthong	U	January, 1887...	Dr. Gresswell.
Newbiggin	U.	June. 1885 ...	„ Page.
Newbold and Dunston ...	U.	„ 1886 ...	„ Spear.
Newcastle-upon-Tyne ...	P.	March, 1885 ...	„ de Chaumont.
Newcastle-upon-Tyne ...	U.	Do. ...	Do.
Newcastle-under-Lyne ...	U.	September, 1886	Dr. Barry.
Newhaven	U.	June, 1885 ...	Mr. Spear.
Newhaven	P.	Do. ...	Dr. Davies.
Newhaven	R.	November, 1885	Mr. Spear.
Newport (Isle of Wight) ...	U.	September, 1885	Do.
Newport (Mon.)	U.	July, 1885 ...	Dr. Blaxall.
Newport (Mon.)	P.	Do. ...	Do.
New Shoreham	U.	Do. ...	Mr. Spear.
New Shoreham	P.	June, 1885 ...	Do.
Newquay	U.	Do. ...	Dr. Davies.
Newquay	U.	January, 1886...	Do.
Newton Heath	U.	April, 1886 ...	Dr. Page.
Normanton	U.	September, 1886	Mr. Spear.
Northam	U.	July, 1885 ...	Dr. Davies.
Northam	P.	Do. ...	Do.
Northampton	U.	December, 1886	Mr. Spear.
Northwich	U.	July, 1886 ...	Do.
Northwich	R.	September, 1886	Do.
Norwich	U.	January, 1886 ...	Dr. Airy.
Nuneaton	U.	July, 1886 ...	Mr. Spear.
Oldbury	U.	May, 1886 ...	Dr. Gresswell.
Openshaw	U.	April, 1886 ...	„ Page.
Ormskirk	U.	October, 1886 ...	„ Parsons.
Ormskirk	R.	Do. ...	Do.
Orrell	U.	Do. ...	Do.
Orsett	R.	June, 1885 ...	Mr. Spear.
Ossett-cum-Gawthorpe ...	U.	November, 1886	Dr. Barry.
Ovenden	U.	Do. ...	„ Parsons.
Over Darwen	U.	Do. ...	„ Page.
Oxford	U.	October, 1886 ...	„ Airy.
Oystermouth	U.	August, 1885 ...	„ Davies.
Padstow	U.	June, 1885 ...	Dr. Davies.
Padstow	P.	Do. ...	Do.
Pemberton	U.	December, 1886	Dr. Parsons.
Pembroke	U.	September, 1885	„ Davies.

Name of District.	Urban, Rural or Port.	Date of Report.	Name of Inspector.
Pembroke	R.	October, 1885 ...	Dr. Davies.
Penistone	U.	February, 1887	" Gresswell.
Penistone	R.	Do. ...	Do.
Penryn	U.	July, 1885 ...	Dr. Davies.
Penzance	U.	April, 1885 ...	Do.
Penzance	P.	Do. ...	Do.
Penzance	R.	Do. ...	Do.
Peterborough	U.	July, 1886 ...	Mr. Spear.
Peterborough	R.	August, 1886 ...	Do.
Pickering	U.	December, 1885	Do.
Pickering	R.	Do. ...	Do.
Plomesgate	R.	July, 1885 ...	Dr. Airy.
Plymouth	U.	June, 1885 ...	" Blaxall.
Plymouth	P.	June, 1885 ...	Do.
Plymouth	P.	March, 1886 ...	Dr. Davies.
Pontardawe	R.	November, 1885	Do.
Pontefract	U.	October, 1886 ...	Mr. Spear.
Pontefract	R.	November, 1886	Do.
Poole	U.	February, 1885	Dr. Davies.
Poole	P.	Do. ...	Do.
Poplar, North	U.	Do. ...	Dr. de Chaumont.
Poplar, South	U.	Do. ...	Do.
Pontypridd	U.	May, 1885 ...	Dr. Davies.
Pontypridd	R.	Do. ...	Do.
Portsmouth	U.	January, 1885 ...	Dr. Blaxall.
Portsmouth	P.	Do. ...	Do.
Portsmouth	P.	February, 1886	Dr. Davies.
Prescot	U.	June, 1886 ...	" Page.
Prescot	R.	Do. ...	Do.
Preston	U.	July, 1886 ...	Do.
Prestwich	R.	May, 1886 ...	Do.
Pwllheli	U.	December, 1885	Dr. Davies.
Quarry Bank	U.	July, 1886 ...	Dr. Gresswell.
Quickmere	U.	October, 1886 ...	Do.
Radcliffe	U.	October, 1886 ...	Dr. Page.
Ramsey	U.	May, 1885 ...	Mr. Spear.
Ramsgate	U.	January, 1885 ...	Dr. Davies.
Ravensthorpe	U.	October, 1886 ...	" Barry.
Rawmarsh	U.	December, 1886	Mr. Spear.
Redcar	U.	December, 1885	Do.
Rhymney	U.	November, 1885	Dr. Davies.
Rochester	U. & P.	March, 1885 ...	" de Chaumont.
Rochford	R.	December, 1885	Mr. Spear.
Romney Marsh	R.	January, 1885 ...	Dr. Davies.
Rotherham	U.	April, 1886 ...	Do.
Rotherhithe	U.	February, 1885	Dr. de Chaumont.
Rowley Regis	U.	June, 1886 ...	" Gresswell.
Runcorn	U.	June, 1885 ...	" Airy.
Runcorn	R.	Do. ...	Do.
Ryde	U.	September, 1885	Mr. Spear.
Saddleworth	R.	October, 1886 ...	Dr. Gresswell.
St. Austell	R.	April, 1885 ...	" Davies.
St. Columb Major	R.	January, 1885 ...	Do.
St. George's in the East ..	U.	February, 1885 ..	Dr. de Chaumont.

Name of District.	Urban, Rural or Port.	Date of Report.	Name of Inspector.
St. Germans	R.	April, 1885 ...	Dr. Davies.
St. Helens	U.	October, 1885 ...	Mr. Spear.
St. Helens (Lancs.)	U.	May, 1886 ...	Dr. Page.
St. Ives...	U.	September, 1885	„ Davies.
St. Neots	U.	May, 1885 ...	Mr. Spear.
St. Thomas	U.	August, 1885 ...	Do.
St. Thomas	R.	Do. ...	Do.
Salcombe	U.	March, 1885 ...	Dr. Davies.
Salford...	U.	August, 1886 ...	„ Page.
Saltburn	U.	December, 1885..	Mr. Spear.
Samford	R.	January, 1887...	Dr. Gresswell.
Sandgate	U.	January, 1885 ...	„ Davies.
Sandown	U.	October, 1885 ...	Mr. Spear.
Sandwich	U.	January, 1885...	Dr. Davies.
Scammonden	U.	January, 1887...	„ Gresswell.
Scarborough	U.	July, 1885 ...	„ Blaxall.
Scholes...	U.	January, 1887...	„ Gresswell.
Seaham Harbour	U.	June, 1885 ...	„ Page.
Sedgefield	R.	February, 1885..	Do.
Sidmouth	U.	September, 1885	Mr. Spear.
Shanklin	U.	Do.	Do.
Shardlow	R.	May, 1886 ...	Do.
Sheerness	U.	March, 1885 ...	Dr. de Chaumont.
Sheffield	U.	May, 1886 ...	„ Davies.
Shepley	U.	January, 1887...	„ Gresswell.
Shelley...	U.	Do. ...	Do.
Sheppey	R.	March, 1885 ...	Dr. de Chaumont.
Sherborne	U.	April, 1885 ...	Mr. Spear.
Sherborne	R.	May, 1885 ...	Do.
Shildon and East Thickley ...	U.	June, 1885 ...	Dr. Page.
Shrewsbury	U.	June, 1886 ...	Mr. Spear.
Sittingbourne...	U.	March, 1885 ...	Dr. de Chaumont.
Skelmanthorpe	U.	January, 1887...	„ Gresswell.
Skelmersdale	U.	October, 1886 ...	„ Parsons.
Skelton and Brotton... ...	U.	December, 1885..	Mr. Spear.
Slaithwaite	U.	January, 1887...	Dr. Gresswell.
Smethwick	U.	May, 1886 ...	Do.
Soothill, Nether	U.	November, 1886	Dr. Barry.
Soothill, Upper	U.	Do.	Do.
Southampton	U.	August, 1886 ...	Dr. Blaxall.
Southampton	P.	February, 1886..	„ Davies.
South Blyth	U.	June, 1885 ...	„ Page.
Southborough...	U.	March, 1885 ...	Mr. Spear.
South Cave and Wallingfen..	U.	May, 1885 ...	Dr. Airy.
South Crosland	U.	January, 1887...	„ Gresswell.
Southend	U.	November, 1885	Mr. Spear.
South Gosforth	U.	October, 1885 ...	Dr. Page.
Southport	U.	October, 1886 ...	„ Parsons.
South Shields...	U.	March, 1885 ...	„ de Chaumont.
South Stockton	U.	Do. ...	„ Page.
Sowerby Bridge	U.	December, 1886..	„ Parsons.
Spalding	U.	October, 1886 ...	„ Airy.
Spennymoor	U.	May, 1885 ...	„ Page.
Standish	U.	December, 1886.	„ Parsons.
Steyning	R.	July, 1885 ...	Mr. Spear.
Stockport	U.	July, 1886 ...	Dr. Page.
Stocksbridge	U.	February, 1887.	„ Gresswell.
Stockton-on-Tees	U.	March, 1885 ...	„ Page.
Stockton	R.	March, 1885 ...	Do.
Stanhope	U.	April, 1885 ...	Do.

Name of District.	Urban, Rural or Port.	Date of Report.	Name of Inspector.
Stoke-upon-Trent	U.	September, 1886	Dr. Barry.
Stoke-upon-Trent	R.	Do. ...	Do.
Stourbridge Improvement Act	U.	May, 1886 ...	Dr. Gresswell.
Stourbridge	R.	June, 1886 ...	Do.
Stratton	R.	July, 1885 ...	Dr. Davies.
Sunderland	U.	March, 1885 ...	" de Chaumont.
Sunderland	U.	July, 1885 ...	" Blaxall.
Sunderland	P.	Do. ...	Do.
Sunderland	P.	March, 1885 ...	Dr. de Chaumont.
Swansea	P.	August, 1885 ...	" Ballard.
Swansea	U.	Do. ...	Do.
Swansea	R.	November, 1885	Dr. Davies.
Swinton	U.	November, 1886	Mr. Spear.
Tavistock	R.	August, 1885 ...	Mr. Spear.
Teesdale	R.	May, 1885 ...	Dr. Page.
Teignmouth	U.	March, 1885 ...	" Davies.
Tenby	U.	September, 1885	" Ballard.
Tendring	R.	January, 1887 ...	" Airy.
Thorne	R.	January, 1886 ...	Mr. Spear.
Thornhill	U.	November, 1886	Dr. Barry.
Thrapstone	R.	October, 1885 ...	Mr. Spear.
Thurlstone	...	February, 1887	Dr. Gresswell.
Thurstonland	...	Do. ...	Do.
Thanet, Isle of	R.	January, 1885...	Dr. Davies.
Tipton	U.	August, 1886 ...	" Gresswell.
Todmorden	U.	November, 1886	Dr. Barry.
Tonbridge	U.	March, 1885 ...	Mr. Spear.
Tonbridge	R.	Do. ...	Do.
Torquay	U.	Do. ...	Dr. Davies.
Totnes	R.	Do. ...	Do.
Tow Law	U.	April, 1885 ...	Dr. Page.
Towyn	U.	January, 1886 ...	" Davies.
Toxteth Park	U.	May, 1885 ...	" Blaxall.
Tredegar	U.	November, 1885	" Davies.
Truro	U.	April, 1885 ...	Do.
Truro	R.	Do. ...	Do.
Tunstall	U.	September, 1886	Dr. Barry.
Tynemouth	U.	September, 1885	" Page.
Tynemouth	R.	Do. ...	Do.
Upholland	U.	December, 1886	Dr. Parsons.
Upper Sedgley	U.	July, 1885 ...	" Gresswell.
Ventnor	U.	September, 1885	Mr. Spear.
Wakefield	U.	August, 1886 ...	Mr. Spear.
Wakefield	R.	October, 1886 ...	Do.
Walker	U.	November, 1885	Dr. Page.
Walsall	U.	July, 1886 ...	" Barry.
Walton-on-the-Hill	U.	May, 1885 ...	" Blaxall.
Wath	U.	December, 1886.	Mr. Spear.
Wavertree	U.	May, 1885 ...	Dr. Blaxall.

Name of District.	Urban, Rural or Port.	Date of Report.	Name of Inspector
Weardale	R.	April, 1885 ...	Dr. Page.
Wednesbury	U.	July, 1886 ...	„ Gresswell.
Wells	P.	„ 1885 ...	„ Airy.
Westbourne	R.	September, 1885	Mr. Spear.
West Cowes	U.	May, 1885 ...	Dr. Blaxall.
West Derby	U.	Do. ...	Do.
West Firle	R.	November, 1885.	Mr. Spear.
West Ham	U.	February, 1885.	Dr. de Chaumont
Westhampnett	R.	July, 1885 ...	Mr. Spear.
West Hartlepool	U.	February, 1885.	Dr. Blaxall.
West Worthing	U.	November, 1885.	Mr. Spear.
Weymouth	U.	February, 1885.	Dr. Davies.
Weymouth	P.	Do. ...	Do.
Worthing	U.	November, 1885.	Mr. Spear.
Whitby...	U.	July, 1885 ...	Dr. Blaxall.
Whitby...	R.	December, 1885.	Mr. Spear.
Whitechapel	U.	February, 1885.	Dr. de Chaumont.
Whitehaven	U.	August, 1885 .	„ Blaxall.
Whitley, Upper	U.	February, 1887	„ Gresswell.
Whittington	U.	June, 1886 ...	Mr. Spear.
Whitwood	U.	November, 1886	Do.
Widnes	U.	September, 1886	Dr. Page.
Wigan	U.	November, 1886	Do.
Wigan	R.	October, 1886 ...	Dr. Parsons.
Wight, Isle of...	R.	Do.	Mr. Spear.
Willenhall	U.	July, 1886 ...	Dr. Barry.
Willington	U.	November, 1885	„ Page.
Williton	R.	December, 1885	„ Davies
Winsford	U.	September, 1886	Mr. Spear.
Wirral	R.	Do.	Do.
Wisbech	P.	August, 1885 ...	Dr. Airy.
Withington	U.	March, 1886 ...	„ Page.
Woodbridge	R.	December, 1885	Mr. Spear.
Workington	U	April, 1885 ...	Dr. Page.
Workington	U.	August, 1885 ...	„ Blaxall.
Workington	P.	Do.	Do.
Worksop	U.	May, 1885 ...	Mr. Spear.
Worksop	R.	„ 1886	Do.
Worsborough	U.	December, 1886	Do.
Wortley	R.	February, 1887	Dr. Gresswell.
Yarmouth, Gt.	P.	November, 1885	Dr. Airy.
Ynyscynhaiarn	U.	December, 1885	„ Davies.
Ystradyfodwg	U.	May, 1885 ...	Do.

INLAND SANITARY SURVEY, 1893–95.

RURAL DISTRICTS of ENGLAND and WALES inspected during 1893–95 as regards their SANITARY CIRCUMSTANCES and ADMINISTRATION.

Name of District.	Population, Census 1891.	County.	Inspector.
1. Atherstone... ...	15,441	Warwickshire ...	Dr. Wheaton.
2. Axbridge	24,965	Somersetshire ...	Do.
3. Barnstaple... ...	19,071	Devonshire ...	Dr. Reece.
4. Barton-upon-Irwell	26,832	Lancashire... ...	„ Bruce Low.
3. Beverley	10,519	Yorkshire	„ Wheaton.
4. Bideford	7,322	Devonshire ...	„ Reece.
5. Bodmin	11,644	Cornwall	„ Wheaton.
6. Calne	5,014	Wiltshire	„ Wilson.
7. Carmarthen ...	23,873	Carmarthenshire ...	„ Reece.
8. Cheadle	22,302	Staffordshire ...	„ Fletcher.
9. Chesterfield ...	59,192	Derbyshire... ...	„ Wilson.
10. Cosford	12,369	Suffolk	„ Fletcher.
11. Crickhowell ...	7,464	Brecknockshire ...	„ Wilson.
12. Daventry	13,709	Northamptonshire..	„ Wheaton.
13. Docking	16,030	Norfolk	Do.
14. Doncaster	28,364	Yorkshire	Do.
15. Downham	15,840	Norfolk	Do.
16. Driffield	13,140	Yorkshire	Do.
17. Durham	32,686	Durham	Dr. Wilson.
18. Eastington... ...	36,782	Do.	Do.
19. Hastings	11,243	Sussex	Dr. Bruce Low.
20. Hemsworth ...	14,631	Yorkshire	„ Wilson.
21. Holbeach	8,599	Lincolnshire ...	Do.
22. Holywell	29,843	Flintshire	Mr. Evans.
23. Houghton-le-Spring	31,445	Durham	Dr. Wilson.
24. Kendal	21,606	Westmoreland ...	„ Fletcher.
25. Ludlow	13,196	Shropshire... ...	„ Bruce Low.
26. Mansfield	21,500	Derbyshire... ...	„ Wilson.
27. Narberth	18,190	Pembroke and Carmarthen.	„ Reece.
28. Newcastle - under - Lyme.	6,174	Staffordshire ...	„ Fletcher.
29. Pembroke	11,763	Pembrokeshire ...	Do.
30. Rochford	17,938	Essex	Dr. Wheaton.
31. Rothbury	6,083	Northumberland ...	„ Fletcher.
32. Runcorn	22,467	Cheshire	„ Bruce Low.
33. Sculcoates... ...	8,786	Yorkshire	„ Wheaton.
34. Spalding	12,719	Lincolnshire ...	„ Wilson.
35. Stone	13,872	Staffordshire ...	„ Fletcher.
36. Sunderland ...	17,552	Durham	Mr. T. W. Thompson.
37. Thanet, Isle of ...	9,466	Kent	Dr. Bruce Low.
38. Warrington ...	12,783	Lancashire... ...	Do.
39. Wharfedale ...	7,551	Yorkshire	Dr. Horne.
40. Williton	15,470	Somersetshire ...	Mr. T. W. Thompson.
41. Wolstanton and Burslem.	32,387	Staffordshire ...	Dr. Fletcher.
42. Woodbridge ...	19,960	Suffolk	„ Copeman.

INDEX TO COUNTY BOROUGHS, MUNICIPAL BOROUGHS, and URBAN DISTRICTS.

[C.B. signifies County Borough. M.B., Municipal Borough. Imp. Act Dist., Improvement Act District. U.D., Urban District.]

Name.	Date of Report.	Name of Inspector.
Consett U. D.	November, 1893 ...	Dr. Wilson.
Coseley U. D.	„ 1894 ...	„ Fletcher.
Cottingham U. D.	June, 1893	„ Wheaton.
Cowpen U. D.	„ 1893	„ Wilson.
Criccieth U. D.	August, 1893 ...	„ Reece.
Cromer U. D.	March, 1893 ...	„ Copeman.
Crowle U. D.	June, 1893 ...	„ Wheaton.
Darlaston U. D.	July, 1894	Dr. Fletcher.
Dawlish U. D.	May, 1894	„ Reece.
Deal M. B.	June, 1893	„ Thomson.
Doncaster M. B.	March, 1894 ...	„ Wheaton.
Drighlington U. D. ...	August, 1894 ...	„ Wilson.
Dronfield U. D.	May, 1894	Do.
Dudley C. B.	August, 1894 ...	Dr. Fletcher.
Durham City and M. B. ...	June, 1894	„ Wheaton.
East Retford M. B.	February, 1894 ...	Dr. Wheaton.
Eccles M. B.	November, 1894 ...	„ Bruce Low.
Eccleshill U. D.	July, 1894	„ Wilson.
Ely City and U. D.	Do. ...	„ Wheaton.
Exeter City and C. B. ...	July, 1893	„ Bulstrode.
Faversham M. B.	April, 1894... ...	Dr. Thomson.
Felling U. D.	September, 1893 ...	„ Wilson.
Fenton U. D.	January, 1894 ...	„ Sweeting.
Filey U. D.	August, 1893 ...	Mr. T. W. Thompson.
Gainsborough U. D. ...	December, 1893 ...	Dr. Fletcher.
Gildersome U. D.	June, 1894	„ Wheaton.
Godmanchester M. B. ...	„ 1893	„ Wilson.
Gravesend M. B.	October, 1893 ...	„ Thomson.
Grays Thurrock U. D. ...	June, 1893	„ Horne.
Great Clacton U. D. ...	July, 1893	„ Reece.
Great Driffield U. D. ...	June, 1893	„ Wheaton.
Great Yarmouth C. B. ...	November, 1893 ...	„ Copeman.
Hanley C. B.	February, 1894 ...	Dr. Sweeting.
Harwich M. B.	June, 1894	„ Wheaton.
Hastings C. B.	March, 1894 ...	„ Bruce Low.
Havant U. D.	September, 1894 ...	„ Thomson.
Haverfordwest M. B. ...	June, 1893	„ Reece.
Heage U. D.	August, 1894 ...	„ Wilson.
Heanor U. D.	October, 1894 ...	Do.
Heath Town U. D.	July, 1894	Dr. Fletcher.
Hedon M. B.	June, 1893	„ Wheaton.
Hereford City and M. B. ...	December, 1893 ...	„ Bruce Low.
Herne Bay U. D.	September, 1894 ...	Do.
Holyhead U. D.	June, 1893	Dr. Reece.
Hoole U. D.	December, 1893 ...	„ Fletcher.
Hornsea U. D.	April, 1894 ...	„ Wheaton.
Houghton-le-Spring U. D.	October, 1893 ...	„ Wilson.
Howdon-on-Tyne U. D. ...	„ 1894 ...	„ Fletcher.
Hoyland Nether U. D. ...	August, 1894 ...	„ Wheaton.
Hunstanton U. D.	March, 1893 ...	„ Copeman.
Hunsworth U. D.	May, 1894	„ Wheaton.
Huntingdon M. B.	September, 1894 ...	Do.
Hythe M. B.	... Do. ...	Dr. Bruce Low.

Name.	Date of Report.	Name of Inspector.
Idle U. D.	July, 1894	Dr. Wilson.
Ilfracombe U. D.	May, 1894	„ Reece.
Ilkeston M. B.	September, 1893] ...	„ Wheaton.
Ipswich C. B.	July, 1894	Do.
Keighley M. B.	February, 1894 ...	Dr. Wheaton.
Kendal M. B.	March, 1894 ...	„ Fletcher.
Kidwelly M. B.	April, 1893 ...	„ Reece.
Knaresborough Imp.Act.Dis.	April, 1894 ...	„ Wheaton.
Knottingly U. D.	January, 1894 ...	„ Wilson.
Leadgate U. D.	November, 1893 ...	Dr. Wilson.
Levenshulme U. D.... ...	July, 1894	„ Bruce Low.
Lincoln City and C. B. ...	May, 1894	„ Wheaton.
Llandudno Imp. Act Dist....	February, 1894	„ Reece.
Llanelly U. D.	April, 1893... ...	Do.
Long Sutton U. D.	September, 1894 ...	Dr. Wheaton.
Longton M. B.	January, 1894 ...	„ Sweeting.
Loughborough M. B. ...	November, 1893 ...	„ Fletcher.
Louth M. B.	September, 1893 ...	„ Bulstrode.
Lower Brixham U. D. ...	October, 1894 ...	„ Wheaton.
Ludlow M.B....	June, 1894... ...	„ Bruce Low.
Lydd M. B.	July, 1894	Do.
Lyme Regis M. B.	April, 1894... ...	Dr. Reece.
Maesteg U. D.	September, 1893 ...	Mr. Evans.
Margate M. B.	August, 1894 ...	Dr. Bruce Low.
Maryport Imp. Act Dist. ...	May, 1894	„ Wilson.
Menai Bridge U. D.... ...	February, 1894 ...	Mr. Evans.
Milford Imp. Act Dist. ...	June, 1893... ...	Dr. Reece.
Millom U. D....	April, 1894... ...	„ Wilson.
Milton - next - Sittingbourne Imp. Act Dist.	Do. ...	„ Thomson.
Minehead U. D.	June, 1893 ...	Mr. T. W. Thompson.
Mold U. D.	December, 1893 ...	„ Evans.
Morley M. B....	May, 1894	Dr. Wheaton.
Morpeth M. B.	July, 1894	„ Wilson.
Newark-upon-Trent M. B. ...	July, 1893	Dr. Bruce Low.
Newbold and Dunston U. D.	June, 1894... ...	„ Wilson.
Newburn U. D.	March, 1894 ...	Do.
Newcastle-under-Lyme M. B.	February, 1894 ...	Dr. Sweeting.
Newquay (Cornwall) U. D.	July, 1894	„ Reece.
New Romney M. B.... ...	Do. ...	„ Bruce Low.
Northam U. D.	May, 1894	„ Reece.
North Bierley U. D.... ...	March, 1894 ...	„ Wheaton.
Norwich City and C. B. ...	May, 1893	„ Copeman.
Oldbury U. D.	August, 1894 ...	Dr. Fletcher.
Ormskirk U. D.	March, 1894 ...	„ Bruce Low.
Paignton U. D.	October, 1894 ...	Dr. Wheaton.
Pemberton U. D.	February, 1894 ...	„ Bruce Low
Pembroke M. B.	August, 1893 ...	„ Reece.
Penrith U. D.	January, 1894 ...	„ Bruce Low.
Penryn M. B.	June, 1893	„ Bulstrode.
Poole M. B.	June–July, 1893 ...	.. Do.

Name.	Date of Report.	Name of Inspector.
Pudsey U. D.	July, 1893	Dr. Horne.
Pwllheli M. B.	August, 1893	„ Reece.
Ramsey U. D.	September, 1894	Dr. Wheaton.
Ramsgate M. B.	August, 1894	„ Bruce Low.
Ripley U. D.	May, 1894	„ Wilson.
Ross Imp. Act. Dist.	December, 1893	„ Bruce Low.
Runcorn Imp. Act. Dist.	December, 1894	Do.
Rye M. B.	September, 1894	Do.
Ryton U. D.	July, 1893	Dr. Wilson.
St. Ives (Cornwall) M. B.	October, 1894	Dr. Wheaton.
St. Neots U. D.	September, 1894	Do.
Salford C. B.	November, 1894	Dr. Bruce Low.
Sandgate U. D.	September, 1894	Do.
Sandwich M. B.	May, 1893	Dr. Thomson.
Seaham Harbour U. D.	Do.	Mr. T. W. Thompson.
Seaton U. D.	May, 1894	Dr. Reece.
Sedgley U. D.	May, 1893	„ Wilson.
Shildon and East Thickley U. D.	September, 1893	Do.
Shipley U. D.	July, 1894	Do.
Shrewsbury M. B.	June, 1894	Dr. Bruce Low.
Sidmouth U. D.	May, 1894	„ Reece.
Sittingbourne U. D.	April, 1894	„ Thomson.
Skegness U. D.	April, 1893	„ Copeman.
Smallthorne U. D.	April, 1894	„ Fletcher.
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